SUGAR BEET

SOME FACTS & SOME ILLUSIONS

A Study in Rural Therapeutics

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SUGAR BEET

TO

THOSE WHO HAVE KEPT THEIR HEADS ON THE
SUGAR BEET QUESTION

ಗ್ರಂಥಾಲಯ
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Friedrich Wilhelm III empfängt Achard.

Achard Presents a Sample of the First
Beet Sugar to Frederick William III

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SUGAR BEET

SOME FACTS AND SOME ILLUSIONS

A Study in Rural Therapeutics

BY

"HOME COUNTIES"

(J. W. ROBERTSON-SCOTT)

Author of "The Townsman's Farm," "Poultry Farming: Some Facts and Some Conclusions,"
"In Search of a £150 Cottage," "Country Cottages," "The Case for the Goat," &c.

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"There are two kinds of sugar. *The first is from plants in which there is sweetness*, and the second is from cane."—THEOPHRASTUS

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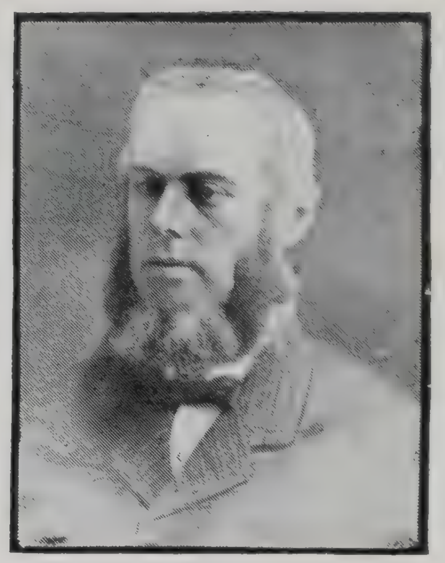
"The manufacture of fresh products of commercial importance from the crops raised on the land has always been the object of the enterprising agriculturist, but oftentimes methods and products are suggested and insisted on by the well-meaning but imperfectly informed reformer of modern agriculture, the adoption of which would not result in the financial success so frequently predicted."—M. J. R. DUNSTAN, *Principal of Wye College.*

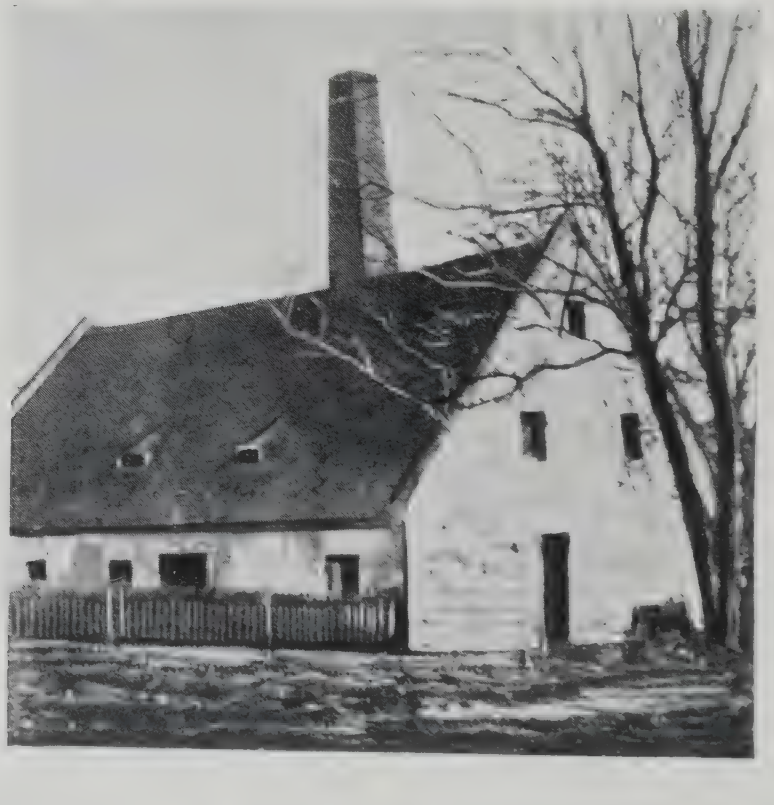
THE BUILDER OF THE FIRST BEET SUGAR FACTORY

Franz Carl Achard, 1753-1821



THE BUILDER OF THE FIRST BEET SUGAR FACTORY IN ENGLAND

James Duncan, 1834-1905



THE FIRST BEET SUGAR FACTORY

Achard's Factory, opened in 1799 at Cunern, in Silesia

INTRODUCTION

There are those who hail Sugar Beet as the saviour of the countryside, and there are those who are sure that the notion of growing our own Sugar at a profit is preposterous.

There are also the Politicians. To them the Sugar Question seems to be, on most occasions, a thing with which to score off one another.

Among them all, the Expert has not much chance of a hearing. With all his merits, he is sometimes prosy, often quite as dogmatic as an Expert ought to be, and now and then—tried soul!—a trifle touchy.

As no beet sugar has ever been made in England—the Lavenham juice was mixed with the syrup of imported raw sugar—the Expert is, of course, a foreigner. And the number of agriculturists who are ready to credit what a foreigner may say about agricultural possibilities in England or to read him in German is not large.

And so we have gone on for years, uttering generalities of approval or disapproval of Sugar Beet growing and of Beet Sugar, or pottering with experiments—there must have been not far short of *five thousand* of them—doing everything, in fact, instead of studying the subject at first hand on the Continent, where there are Sugar Beet growers, Beet Sugar factories, and Sugar Beet savants, with some generations of practical experience and profit-making behind them, and a Sugar Beet literature and journalism of surprising extent and thoroughness.

Last autumn and early this year I took a great deal of pains in writing a dozen and a half articles in the *Field* ("The Sugar Beet Question: An Inquiry") and the *Times* ("The Proposals for a Beet Sugar Industry"). I had the advantage of having just visited two Beet growing countries, where I had enjoyed official facilities for agricultural investigation. Some readers, eminent in our agricultural world, and some other readers, familiar with Sugar Beet growing on the Continent, were good enough to write that the sober view I had taken was so unusual and so serviceable that it would be a pity if the articles were not reprinted. Having gone so far into the subject, and having the advantage of living in Essex, where a really commercial attempt at Sugar Beet growing had been made, I accordingly set to work to arrange what I had written. I am afraid, however, that my friends will find a difficulty in discovering in these pages the articles which my editors so kindly gave me permission to reprint! What is now offered to the student of rural problems is a new book, which I realise, as I think ruefully of my lost Spring, has made very large demands indeed on my time—and my pocket.

Sugar Beet has been the subject of such amazing fictions that it was certainly well worth while that somebody should take the trouble to lay bare, once and for all, the substratum of fact—a respectable substratum, as will be seen—upon which they have been reared.

The time has come, to change the metaphor, when the subject must be thoroughly threshed out. If there is, as the result of the threshing, a yield which promises to be profitable, let the starting of the pioneer factory be set about. If there is an insufficient return from the threshing, let us have done with the matter, and do our best to turn the limited leisure of the agricultural world in a more hopeful direction.

In explanation of the space given to the details of the East Anglian experiments of 1910, the reader may be reminded that early in 1911 there was no certainty whatever as to farmers apportioning land to Beet this year, and that the area which has been actually devoted to it is not large. In any case, it is most desirable that the facts as to the first attempts to grow Beet commercially in England should be frankly and fully recorded. We need all the insight which the rude experiences of 1910 can give us into the practical agricultural difficulties attending Sugar Beet growing in England by *other than picked farmers on picked land.*

One identified with the proposals for a Sugar Beet industry suggested to me deprecatingly that the time to write a book would be at the end of the year. In view, however, of the probability of extravagant conclusions being drawn from the cropping of 1911, I am not alone in holding that it is of importance that the basic facts of the situation should be unmistakably seen *at the time when those conclusions are likely to be pressed.*

That the case for a Sugar Beet industry is a strong one is evident, I think, in every chapter of this book. But no good can come of looking at less than the whole of the facts. And it is not to be denied, first, that a very large proportion of what has been written and spoken on the subject hitherto has been lamentably one-sided, and, second, that there is small reason to believe that we have heard the last of such unfair and dishonest, or let us charitably say, uninformed advocacy.

Even if a Beet Sugar factory should never be started in this country, I shall not regret the time spent on the study of an episode in our agricultural history which has surely some permanent value for us as an object lesson in Rural Therapeutics.

When the book was in type and in pages, Lord Denbigh and the directors of the National Sugar Beet Association were kind enough to give Mr. R. N. Dowling permission to hand me the Report which he had made to them on his inquiries, in May and June, 1911, in France and Germany. I am greatly indebted to Mr. Dowling for having devoted a day or two to supplementing the Report by a series of Conclusions which, in view of his practical and scientific agricultural experience, will be attentively considered. The condensed Report and the Conclusions are printed as an Additional Chapter.

Anyone who should pick up this book and lack time to read it as a whole may confine his attention to Chapters I., II., (XVI., XVII., and XVIII.), XXIII., XXIV., and XXV., ignoring, if absolutely necessary, the chapters in brackets. But long as the book is, I venture to think that it is not one page too long in order to give a wholesome and abiding impression of the extraordinary complexity of the subject, and of the mass of details, some acquaintance with which must be made before it is possible confidently to set about Beet growing and Beet Sugar manufacture as a National Industry. The best course is to go through the work from the beginning, skipping cultural and statistical details. When these details are wanted, reference can easily be made to them by means of the Contents, side headings, and Index.

Although the pages which follow have been the subject of unremitting care in their progress through the press, and, by the kindness of many friends, have been widely read in proof, there are endless possibilities of error in dealing with a question which involves the discussion of so many details. I shall be most grateful, therefore, for corrections or suggestions—or new data—likely to lead to the greater usefulness of the first work to be published in England dealing exclusively with Sugar Beet and Beet Sugar.

Among those whose names are frequently mentioned in this book I am indebted first and foremost to the veteran Mr. George Martineau, C.B. There can be few pages which have not benefited by an encyclopædic knowledge of the sugar industry which, despite the burden of seventy-five years, has been placed at my service, with unstinted and generous kindness, for months. I am also under very special obligations to several gentlemen who, like Mr. Martineau, have most kindly looked through the whole book in proof, in some cases more than once: Mr. A. D. Hall, F.R.S., of Rothamsted, whose interest in the sugar beet question is of long standing, and whose helpfulness to those in search of sound information bearing on any agricultural problem I do not profit by for the first time; Dr. G. Schack-Sommer, who conducted some of the earliest experiments, and has given me every assistance in his power; Dr. O. Rabbethge, of the famous Klein-Wanzleben house, who has been ever prompt to answer my numerous inquiries as to German conditions and usage; Mr. A. O. T. Bennett and Mr. Anton Schobloch, whose acquaintance with agricultural conditions both in Germany and England made their criticisms and help particularly valuable; Mr. J. M. Hummelinck, who has been of much assistance to me by correspondence, and during my visits to his firm's factory in Holland; Mr. W. E. Sawyer, who has kept me fully informed as to the developments in Norfolk, with which he has been closely identified, and kindly took for me the photographs of the Dutch implements; and Mr. Trustram Eve and Mr.

William Hasler, two English directors of the East Anglia Company, whose intimate knowledge of farming practice is widely recognised. No one has shown a keener interest in the possibilities of Sugar Beet than the Secretary of the Farmers' Club, and the help given me by my neighbour, Mr. Hasler, at the early stages of my book especially, was considerable.

I hasten to add that I alone am responsible for all that is written in this book which is not expressly attributed to others.

I am also indebted to the Right Hon. the Earl Carrington, K.C.M.G.; the Right Hon. the Earl of Denbigh, the Hon. Edward Strutt, Sir J. Cotterell, Bart.; Sir Walter Gilbey, Bart.; Sir Thomas Elliott, K.C.B.; the Directors General of the French and Netherlands Ministries of Agriculture; Dr. F. B. Skalweit, of the Consulate-General of the German Empire; the Consuls-General of France and of Belgium; Dr. J. J. Van Ryn, Agricultural Commissioner for the Netherlands; Mr. Harald Faber, Agricultural Commissioner for Denmark; the Director of the Sugar Institute, Berlin; the Deutsche Landwirtschaft Gesellschaft, Professor T. B. Wood, Mr. F. M. Beck, Messrs. Carter and Co., Mr. G. L. Courthope, M.P.; Miss Eily Carter, Mr. P. Champion, Mr. Ali Cohen, Messrs. Czarnikow, Mr. Clement Dalley, Mr. H. C. Everard, Mr. Sam Mendel, Mr. H. Fry, Mr. Prinsen Geerligs, Mr. H. Rider Haggard, Mr. David Hasler, Mr. R. W. Hobbs, junior; Mr. E. Houbolt, Mr. A. J. Keith, Messrs. Kühn and Co., Mr. C. Lagemann, Mr. R. M. Leonard, Mr. George Mathieson, Mr. C. A. McCurdy, M.P.; Mr. H. Lassberg, Professor F. J. Lloyd, F.C.S., F.I.C.; Dr. C. S. Morrison, Mr. B. E. R. Newlands, F.C.S., F.I.C., from whom I have had some interesting letters; Mr. John Percival, M.A., Director of the

Agricultural Department, Reading; Mr. G. J. Petitpierre, Messrs. Stanford and Son, Mr. Arthur Symonds, Mr. F. V. Theobald, M.A.; Mr. H. Turner, and Mr. J. M. Welch.

Mr. Martineau's authoritative manual, "Sugar: Cane and Beet: An Object Lesson" (Pitman, 1s. 6d.), which, whatever view may be taken of its political conclusions, is most valuable for the technics and history of the sugar industry, has been, as my constant references and quotations bear witness, always on my desk. Mr. B. E. R. Newlands has also most kindly made me free of that great tome of his, "Sugar: A Handbook for Planters and Refiners" (Spon, 25s.), a new edition of which came out only last year. "La Betterave à Sucre," of Professor Malpeaux (Hachette et Cie., 1fr. 50); the successive numbers of the always serviceable *International Sugar Journal* (Altrincham, 1s. monthly), the *American Sugar Industry and Beet Sugar Gazette* (Chicago, Ill., 20 cents), and its *American Sugar Beet Growers' Annual* have all yielded useful data. A series of practical articles by Mr. A. Koppeschaar in the *International Sugar Journal*, Mr. Norman Rodger, its editor, kindly gave me special permission to utilise.

I have to acknowledge the kindness not only of the Editor of the *Times*, and of Mr. Theodore A. Cook, editor of the *Field*, but of Mr. James Sinclair, editor of the *Agricultural Gazette*, and Mr. Chalmers Roberts, editor of the *World's Work*, through the columns of whose publications some portions of the book ran in the proof stage. The Comptroller of H.M. Stationery Office was good enough to give me permission to quote freely from the *Journal of the Board of Agriculture*, and to reproduce an illustration. I am indebted to Dr. Rabbethge, of the Klein-Wanzleben Zuckerfabrik, and to Messrs. Wohanka and Co.'s well-known seed-breeding station at Prague for gifts of photographs. Many illustrations are from photographs which Mr. J. M. Hummelinck, of the Hollandia Co., kindly gave Mr. J. Stok, of Rotterdam, facilities to take for me at various times. The diagrammatic sketches, made for me by Mr. W. G. Keith, and some other illustrations, were kindly lent by the courtesy of Mr. J. M. Bulloch, editor of the *Graphic.* The little cartoon at the beginning of Chapter XXII was drawn by Mrs. Robertson-Scott. I am under obligations to the Gresham Company for the use of the blocks from their big "Encyclopædia of Agriculture," to Messrs. Duckworth and Co. for the loan of blocks from Mr. John Percival's excellent "Agricultural Botany," to Mr. Hal Williams, M.I.M.E., and the editor of the *Journal of the Society of Arts*, for the loan of two illustrations which appeared therein, and to Messrs. Breitfeld, Daněk, and Co., of Prague; Messrs. Dippe, of Quedlinburg; Messrs. Siedersleben, of Bernburg; and the Etablissement A. Bajac, of Liancourt, for the loan of blocks.

A number of blocks have been lent to me by the *World's Work,* in which they illustrated articles of mine, and three from the East Anglia Company's "Hints on Cultivation." Two drawings of implements are made from the catalogue of the Deere and Mansur Co., Moline, Ill. I have also to acknowledge the courtesy of Messrs. Spon and Mr. B. E. R. Newlands for the loan of a block from "Sugar," and to Messrs. Carter and Co. for the use of the illustration of the polariscope and for permission to have photographs of pulp and sugar samples taken. The Agent-General of Queensland has also kindly lent me a block.

Great Canfield, Dunmow,
August, 1911.

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(*a*) By the courtesy of the *Graphic*; (*b*) of the *World's Work*; (*c*) of the Gresham Publishing Company ("Standard Cyclopædia of Modern Agriculture); (*d*) of Messrs. Duckworth and Co. ("Agricultural Botany," by John Percival); (*e*) of Messrs. Breitfeld, Daněk, and Co., Prague; (*f*) of the Comptroller of H.M. Stationery Office (*Journal of the Board of Agriculture*); (*g*) of the East Anglia Sugar Company ("Hints on Cultivation"); (*h*) of Messrs. Carter and Co., Raynes Park; (*i*) of the *American Sugar Industry*. Chicago; (*j*) of Dr. O. Rabbethge; (*k*) of Mr. W. E. Sawyer, Roughton, Norwich, who took the photographs; (*l*) of Messrs. Wohanka and Co., Prague; (*m*) of Messrs. Deere and Mansur Co., Moline, Ill.; (*n*) of Mr. Hal Williams and *Society of Arts Journal*; (*o*) of Monsieur A. Bajac; (*p*) of Messrs. Dippe, Quedlinburg, Germany; (*q*) of Messrs. Russell and Co., Maldon: (*r*) of the Agent-General for New Zealand; (*s*) of Mr. B. E. R. Newlands, F.C.S., F.I.C. ("Sugar," Messrs. Spon and Co.); (*t*) of Messrs. W. Siedersleben and Co., Bernburg, Anhalt; (*u*) of the *East Anglian Times*; and (*v*) of Messrs. John Fowler and Co., Leeds.

VILMORIN (BRABANT) BEET

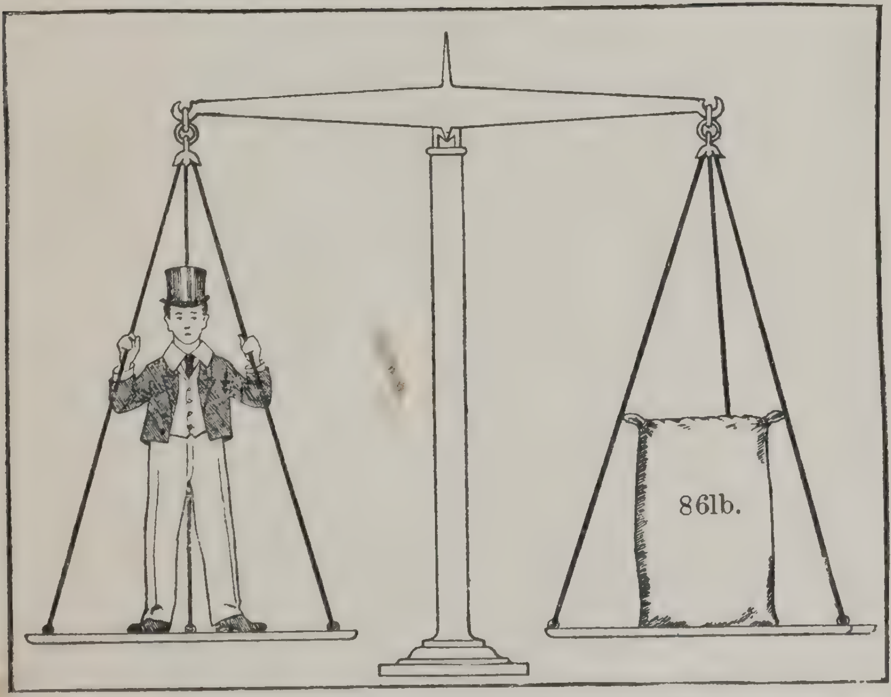
"All that I have proposed to myself is to say This and this I have learned; but do not thrust on my shoulders the responsibility for your own laziness if you elect to take, on my authority, conclusions the value of which you ought to test for yourself."—HUXLEY.

"Never rely on controversy to convince. Say what you have to say and leave it."—MARK RUTHERFORD.

CHAPTER I

THE PROPOSALS FOR A BEET SUGAR INDUSTRY

The Situation.—More sugar is consumed per head of the population in Great Britain than in any other country.* Four-fifths of this sugar is beet sugar (which, although there is a widespread impression to the contrary, no one can tell from cane sugar). All this beet sugar is produced from beets grown on the Continent. Some of the sugar is refined in this country, but most of it is not only manufactured but refined abroad. It is natural that



THE SUGAR WE CONSUME PER HEAD PER YEAR.

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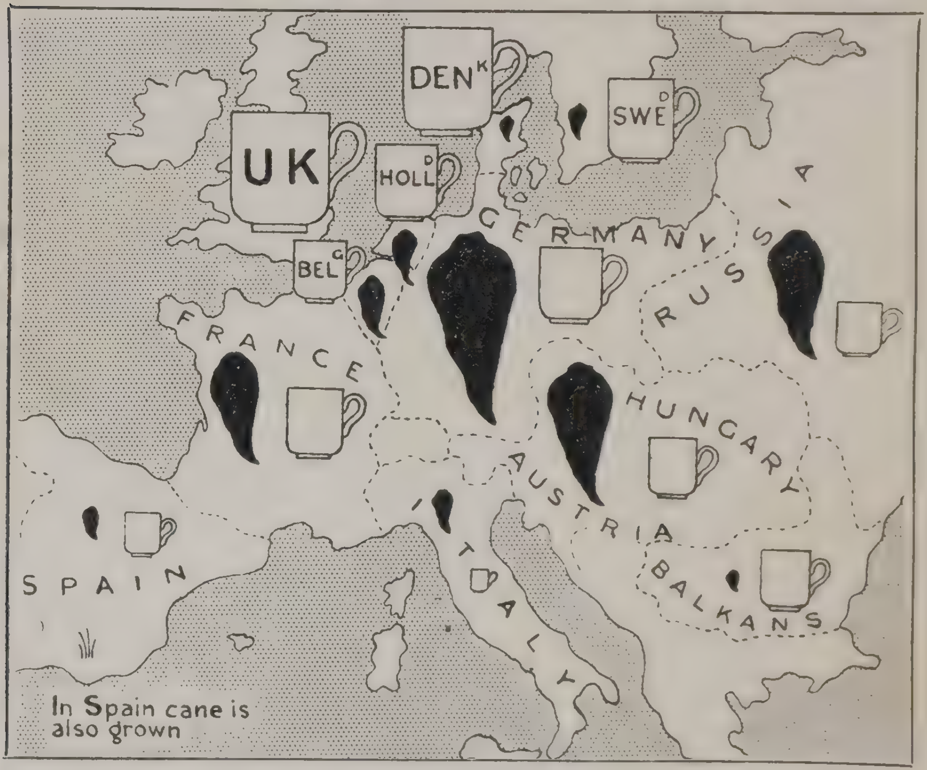
* For latest statistics, *see* Appendix.

public attention should be directed from time to time to such a state of things.

And the Problem.—Can a sugar industry be profitably established here? During the year 1910 a great deal was done towards answering the question. Hitherto we have had nothing but the records of experimental plots to go upon. Such "kitchen-gardening work," as a German expert has called it, has no small value, and unstinted thanks may be given to the pioneers who undertook it. But to deduce from the weight of a few yards, chosen from an experimental plot of roots, the crop per acre, and from that the probable average crop per acre for the whole countryside, as has been so frequently done, and, to the

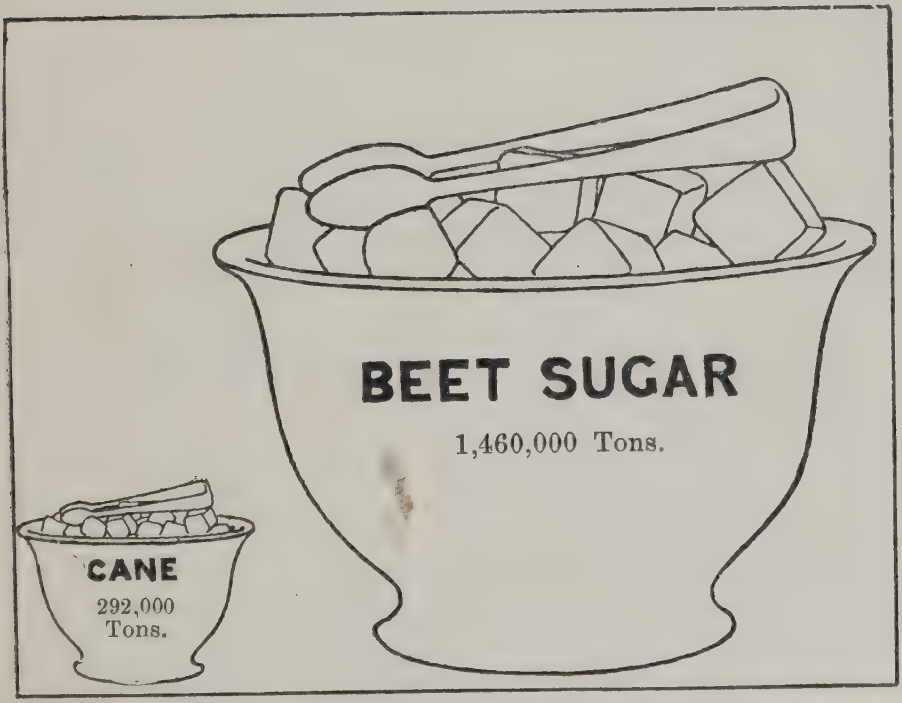


In Spain cane is also grown

European Production of Beet Sugar and Consumption per Head.
Represented by the relative size of the sugar beets and teacups.

mystification of the public, is still being done, is an ingenuous method of procedure which can hardly be expected to impress farmers. The only convincing test is a test carried out on commercial areas in ordinary agricultural conditions.

The Coming of the Dutchmen.—This test may be regarded as having been made in the case of the beet grown in East Anglia for the Dutch firms which are inclined to take some part in the establishment of sugar factories in England if agricultural and financial encouragement is forthcoming. The impression left on the minds of experts who made themselves acquainted with the East Anglian crops and have examined such of the previous experimental plot work as is trustworthy, is that there are no climatic difficulties which need stand in the way of producing



THE SUGAR CONSUMED IN GREAT BRITAIN IN A YEAR.

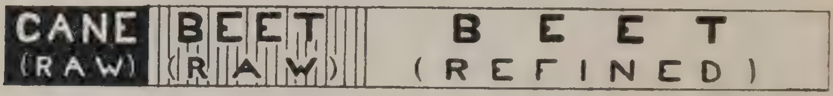
throughout considerable districts in England—and, of course, in Ireland—beet to a weight and sugar percentage equal to or even in excess of the average Continental weights and percentages. But assuming this to be an accurate impression, there remain three problems:

(1) Can the crops be grown to a profit?

(2) Can a sufficient number of farmers in the immediate vicinity of such factories as might be built be relied upon to grow beet properly year after year?

(3) Would these factories pay?

Our First Experience on a Commercial Scale.—All sorts of paper profits have been put before farmers. Such calculations are as often as not exaggerated, and almost in every case they seem to take small account of the fact that we have root crops in this country already, root crops which are grown extremely well, and are, of course, of great value. The profits seem frequently to be reckoned on a cost of production per acre which is actually exceeded in many parts of Germany. Further, the balance-sheet makers appear to proceed on the assumption that our farmers—skilful root-growers, sufficient capitalists, and enlightened business men though they may be—will begin beet cultivation with the experience which Continental growers have only obtained by a long apprenticeship to the crop.



Our Sugar Imports.

No doubt the beet grown for Holland in East Anglia suffered under the great drawback of being sown late and in insufficiently prepared ground,* but this is only to say

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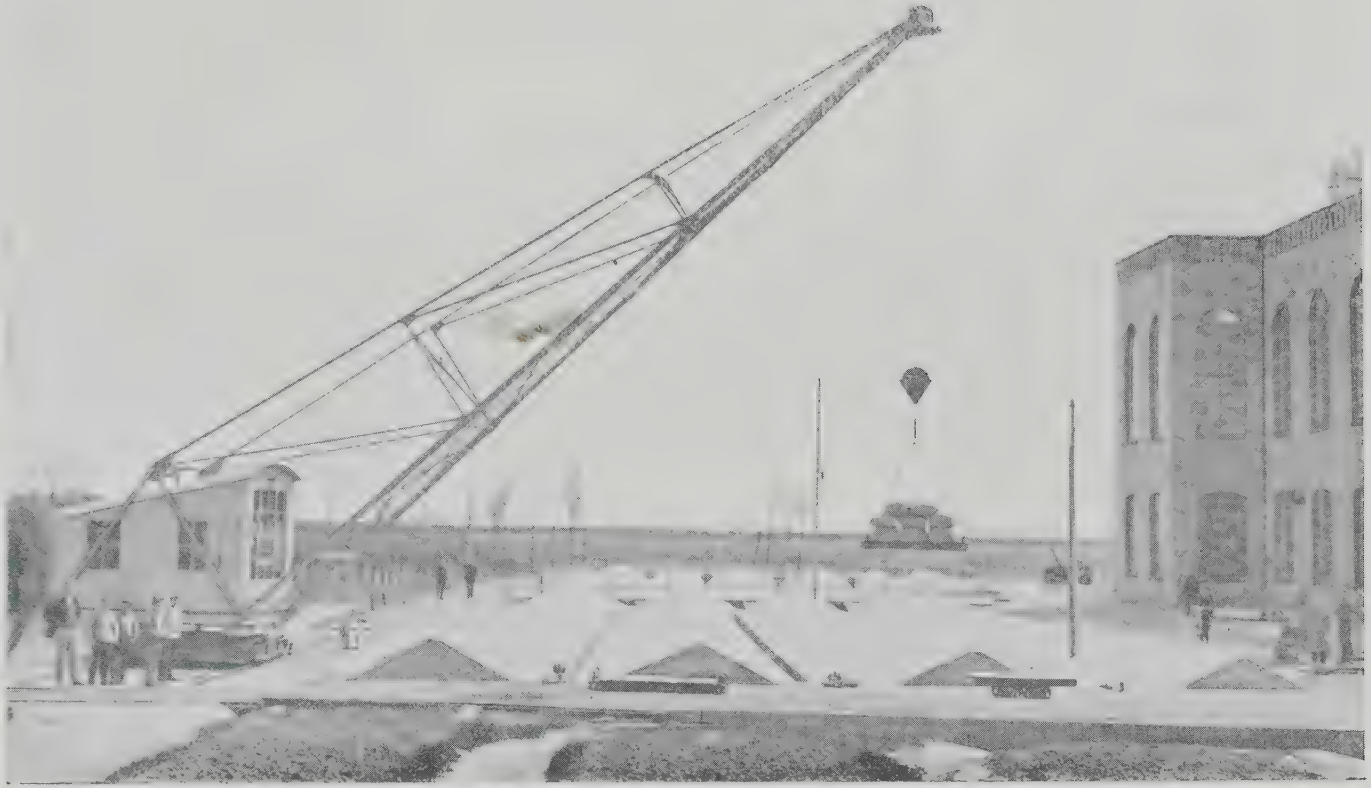
* Obviously sugar beet areas must be arranged for in the autumn. In East Anglia odd fields only could be secured.



At the Hollandia Factory before the Arrival of the Beets

The concrete slopes and gutters on which the beets are piled. The crane is being used for the transportation of sugar

that the requirements of the crops were not understood. The bad singling, the insufficient hoeing at an early stage, and the different widths at which rows were drawn point in the same direction. The friction between the farmers and the enterprising Hollandia Company—which has done excellent educational work in Essex and Suffolk—is eloquent of the difficulties likely to confront an English factory in dealing with those to whom the growing and harvesting of beet is unfamiliar. The roots are paid for at washed weights, and the amount of soil which some of the East Anglian growers seem to have proposed to market with their beets (although expressly warned in their contracts against trying to do so) rose to an exceedingly high percentage. The net crop averaged only about 7½ tons or so an acre, against 10·6 tons for the whole of Holland, 11·2 tons for the whole of France, and 11·8 tons for the whole of Germany.

Arguments for the Industry.—When, however, all is said that may be said as to the obstacles in the way of starting a sugar industry in this country—and it is abundantly clear that only those who have spent a great deal of time in going practically into the subject realise the extent of those difficulties—there remain the facts:

(1) That there is an increasing demand for sugar.

(2) That while cane sugar may be said to have cheap labour at its back, beet sugar commands disciplined labour and has the advantage of possessing on the spot the best scientific knowledge and a friendly market.

(3) That, whatever the cash returns of the farmer may or may not be from beet, Continental and American experience shows that the indirect value of the crop is considerable not only in forwarding succeeding crops manurially, but in inducing deep cultivation. The

cleaning given to the ground by the constant hoeings has also to be taken into account.

(4) That there is a sociological argument of some weight for the new crop and industry.

(5) That the Germans, who by now must surely be beginning to exhaust the advantages derived from the abolished bounties, who have no advantage from import duties which the other signatories to the Brussels Convention cannot command,* and spend more on the growing of beet, and often on coal for their sugar factories, than is generally supposed, seem to find it profitable to continue to devote themselves to beet.

Arguments Against the Industry.—On the other hand we have to remember:

(1) That beet largely occupies in Germany the place held here by other root crops, and I learn that no new sugar factories have been built within the Empire during the past five years. The increase in the number of American factories does not count, as the United States is outside the Convention, and the sugar makers there benefit by a 7s. duty.

(2) That we are faced not only by agricultural inexperience, but by some agricultural indisposition to learn.

(3) That there is a demand from the only agricultural districts which have experience of beet-growing on a commercial basis that a higher price shall be paid per ton for beets than has been offered hitherto on behalf of any proposed factory.

(4) That the price of sugar has been below what experts in the past have declared the level ought to be for an industry to have a chance of success.†

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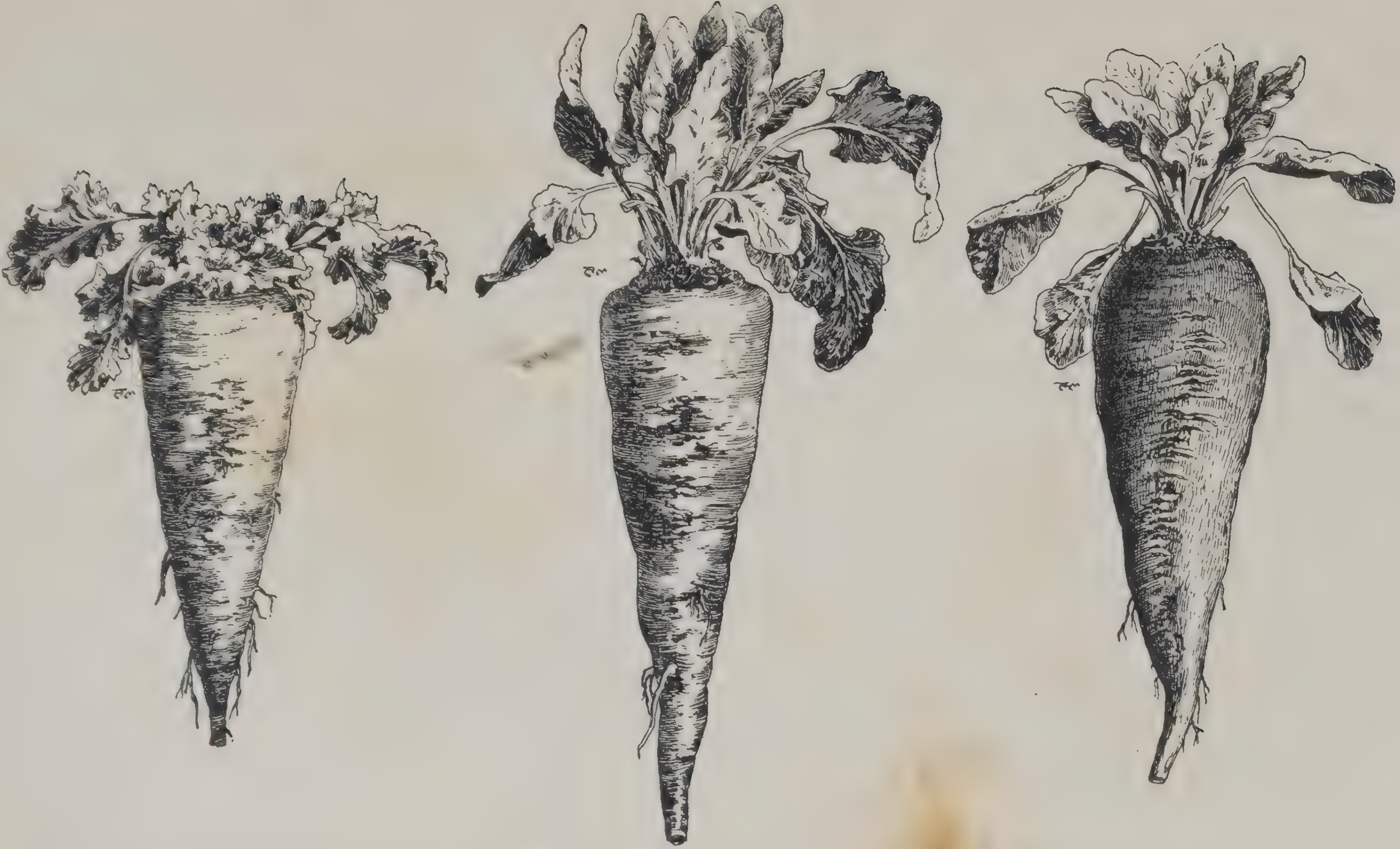
* *See* Chapter XXII.

† While these pages have been in preparation the price has gone up from 9s. to 10s. 7½d. Whether it will stay there is another question.



SOME VARIETIES OF SUGAR BEET.

1. Klein Wanzleben. 2. Vilmorin White. 3. Vilmorin à colle rose.

The Hope, and How it Might be Realised.—There can be few students and well-wishers of rural England who do not cherish the hope that the experiment of a sugar factory will be tried. But it is idle to ignore the fact that, although the sugar content of beet has risen remarkably, and our acquaintance with the crop and the conditions of successful sugar manufacture have grown materially since the seventies, the necessity of guarding against that over-confidence on the one hand and agricultural indifference on the other which helped to wreck James Duncan's enterprise at Lavenham, still remains.

It is also the case that if a factory is not only to manufacture sugar but, as has been suggested, to refine purchased Continental raw sugar as a means of keeping open all the year round and of increasing the prospect of dividends, the capital expenditure involved must be considerable, and the experience much greater.

Again, German factories have gradually paid off a large amount of their indebtedness out of profits, and that fact should be remembered in taking note of the size of their dividends in relation to the amount of their apparent capital. It need hardly be added that, if the first English factory is to have a fair chance, great foresight, the utmost economy, and the largest possible command of Continental experience are imperative. There is much to be said, indeed, in the case of a first venture, for taking Continental sugar manufacturers into partnership.

From a purely agricultural point of view there is most hope for an Anglo-Dutch experiment in North Norfolk. Of the Kidderminster enterprise it may be said that it has at least the agricultural advantage of suitable soils and skilful root-growers. In East Sussex, where Mr. Courthope would like to see a factory tried, there is not, from the point of view of root-growing, such promising farming.

CHAPTER II

AT A BEET SUGAR FACTORY

Strings of beet cars, dingy and brown,
Stand waiting near,
To drop their sweet burdens rumbling down
When the way is clear.

Up to the bins the beet waggons climb,
Bearing full weight,
And drop their huge loads in record time
To the sloping grate.

Huge hills of limestone, dingy white,
Rear up their crest
Beyond the coal piles, whose treasured might
The boilers wrest.

Along the flume, with splash and roll,
The white beets flow;
Tearing along to the twisting scroll
They madly go.

The pressed pulp bursts like a torrent freed
From its narrow box,
Filling the cars and waggons with feed
For the hungry flocks.

From warehouse to car the sacked sugar goes,
Thousands each day.
Loaded and packed in regular rows,
They start on their way.

—"*The Beet Sugar Factory.*"

The Roots.—The best way of plunging into the beet sugar question is to visit a beet sugar factory. The first surprise that awaits the novice at such a place is the beet itself. Instead of a root or bulb like the little red-skinned garden beet, which must be tenderly handled, both in digging up and in cooking, he sees a big, rough-looking parsnip, white outside and inside, with not only its leaves but its crown or top cut off. Nine out of ten English people who came upon a pile of sugar beets would undoubtedly take the roots for parsnips.

Hills of Beets.—In Holland in October one sees heaps of beets, just a little withered by exposure, accumulating by the sides of the canals, and now and then at railway stations. In the Netherlands most of the beets are, of course, transported by water; indeed, the large sugar factory which I shall describe in this chapter is right away from the railway. Every beet it gets comes by water. I counted forty-three sailing barges and steamers discharging beets upon the space between the factory and the canal. There were piles reaching as high in some places as the third storey of the factory. They are an extraordinary sight. I found each of the three chief heaps to be at its base about fifty-four yards by twenty-six. I do not know what weight of beets had been accumulated on the ground, but in past seasons there have been as many as 15,000 tons lying together at a time.

The "Sugar Campaign."—Every effort is made to get the beets ashore as quickly as possible. Not only were the carriers of the two great electric cranes being filled and emptied at top speed, but the barges were getting their cargoes ashore at a rapid rate. One barge alone managed to keep a series of six baskets going. The need for haste is well known. If the beets are frosted they suffer considerably from the succeeding thaw. To store the beets indoors is not practicable; they would heat. To make pits is quite practicable, but means wages. The best thing to do is to get the beets into the factory as soon as possible.*

Just as they come into the factory at top speed, so must

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* This description was written in mid-October.

To Avoid Stopping the Factory.—In Holland there is a special reason, in addition to the reasons stated, for running the sugar campaign at top speed. There is a possibility of the beet-laden barges, if their trips are postponed until January, getting caught in the ice which frequently closes the canals. For the complicated machinery of a beet sugar factory to be stopped for lack of beets is a source of serious loss, as will be realised by the reader when the character of the process by which the sugar is obtained from the beets is described. The railways cannot come to the rescue of the they also without loss of time be converted into sugar. The whole organisation of a beet sugar factory is contrived for quick work. The period during which sugar is being made is amazingly short. In 1909, this factory began sugar-making on October 18, and finished on December 24—that is, the season, or, to use the trade name, the "sugar campaign," lasted for only sixty-seven days, but days of twenty-four hours, for once sugar-making begins it goes on day and night, Sunday and weekday, without a break. In 1910 enough beets had accumulated for a start to be made on October 7, and work ceased on December 7.*

The Beets Enter the Factory.—The space between the canal and the factory, on which the beets are piled, is a series of concrete trenches. Water is pumped into these slopes—warm waste water from the factory—and, as they are connected to a trench which goes right into the building, the result is that the beets gradually float themselves into the building. This is an arrangement which not only saves labour, but detaches from the beets a great deal of the earth which clings to them. Remember, the factory buys

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factories, for they have no more rolling stock than will suffice for their ordinary needs.

Beets and Frost.—"So far as freezing of beets is concerned, a very light covering suffices for protection, while, on the other hand, frozen beets are not objectionable to the factory people so long as they do not experience alternate freezing and thawing. Frozen beets are not quite so easy to work, require a different treatment, and for other reasons are not wholly desirable; but, so long as disintegration has not set in, are usually acceptable."—*American Sugar Beet Growers' Annual.*

The climate of England is not such that beet will often need to be protected from frost, if deliveries are taken early.

* The sugar campaign of the sixty-five beet sugar factories in the United States averaged, in 1909, eighty-three days. *See* Appendix for German figures.

its beets by net weight. This is arrived at by taking a sample of each cargo, putting it with water into a kind of railway milk churn, and placing the churn on rollers, which keep it revolving until the beets are perfectly clean.* The average sugar content of each lot of beets is determined by analysis.

Washing and Slicing.—The first thing that happens to the beets when they float themselves into the factory is to be caught up with a certain amount of water in the clappers of a kind of water wheel. This contrivance drops them into a sluice. In the sluice there are a number of agitators like the propellers of a steam launch, and they give the beets a lively time. Further cleansed by their experiences in the clappers and among the propellers, the beets pass rapidly along, to find themselves shot down into another sluice, at the bottom of which they are caught by a hoist and carried right to the top of the building.

Here, never having ceased their forward movement from the time that they were first set in motion by the flooding of the concrete slopes out of doors, they are thrown into a carrier, which weighs them, half a ton at a time, and then drops them into two steel vats containing sets of villainous-looking knives. These knives are not the least interesting things in the factory. About a dozen men do nothing else but keep sharpening relays of them. The action of the knives is such as quickly to cut the beets into strips about 5in. in length and about the thickness of macaroni, but square in shape. These beet slices, as they are called, drop into a travelling arrangement which takes them into a trough which extends about 6ft. above the floor of a large building and along almost its entire length. From this trough the slices are shot into "diffusers."

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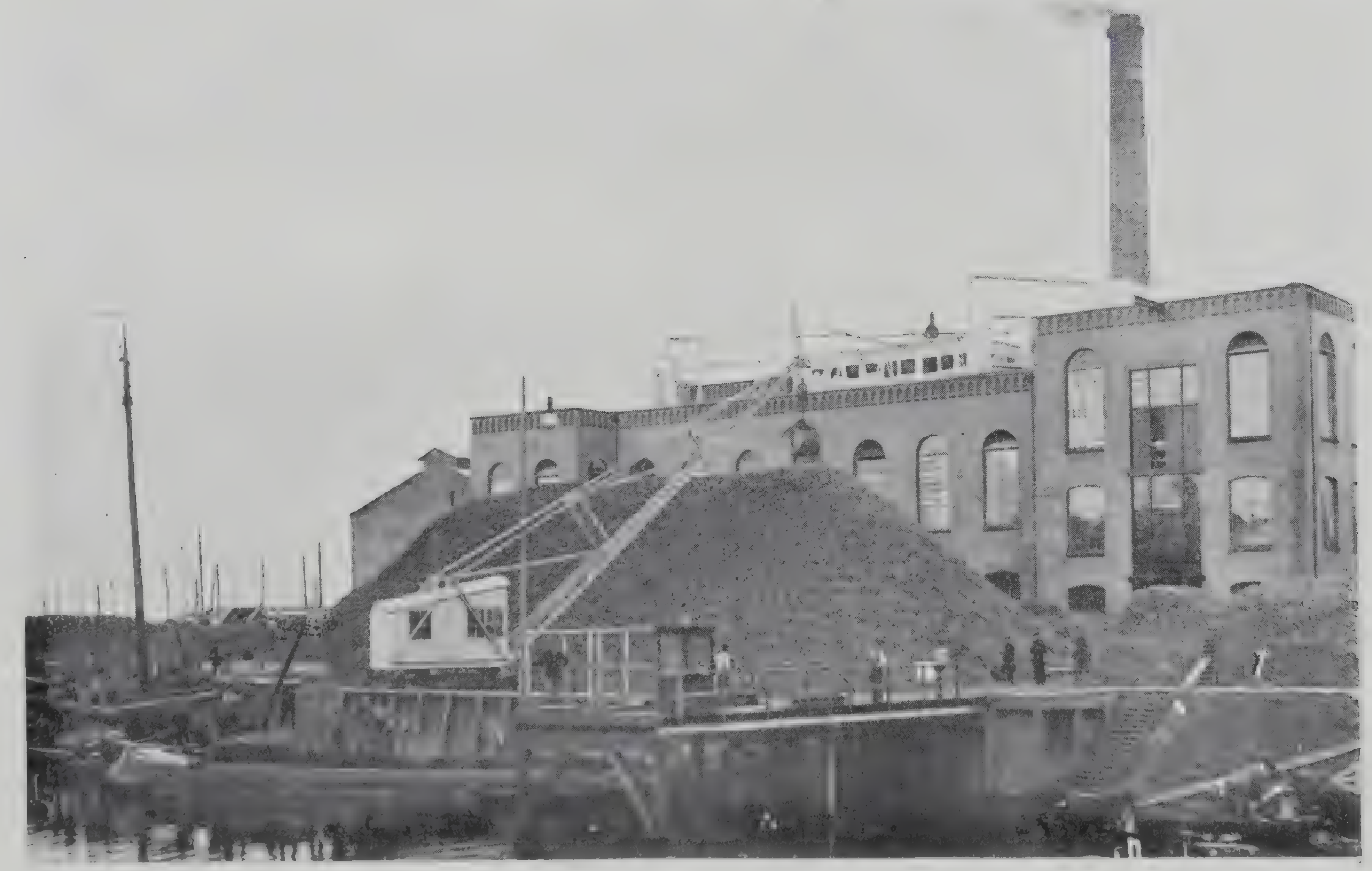
* There are other methods in use at other factories.



One of the Piles of Beets in Front of the Hollandia Factory

Note the masts of the barges bringing beets

Beet Juice and Water.--The diffusers do the work of a giant teapot. There is a whole row of them. They are teapots with tight-fitting lids at the bottom as well as at the top. Each teapot is connected with its neighbour by means of a pipe. Down come the beet slices through a shoot from the trough aforesaid and fall into teapot No. 1. To the slices are quickly added, from a tap near each teapot lid, the requisite amount of hot water. Beet slices are dropped in the same way into all the other teapots, but the makers of the brew are not content with the strength resulting from one "drawing." They run off the decoction obtained from No. 1 teapot into No. 2, where it draws the sweetness out of the slices there accumulated. In the same way the liquor is conducted through the whole series of teapots. As a result this "thin juice," as it is called, is as good as it can be. The water is acting on the slices under pressure. The process by which the sugar passes from the beet cells in the slices into the water is that of diffusion. It has such an important bearing on the success of the industry, that I quotet he following clear description from Mr. Martineau's admirable handbook, "Sugar" (Pitman, 1s.):

> When two liquids of different densities are separated by a membraneous partition, a process of diffusion takes place, the denser assing into the lighter, and the lighter into the denser. If the denser liquid contains in solution a mixture of crystallisable and uncrystallisable substances, the former will diffuse freely into the lighter liquid, while the uncrystallisable will hardly diffuse at all. The phenomenon is called osmosis. If there should be on one side of the membrane a quantity of the juice of the beet containing crystallisable sugar, mingled with gummy and gelatinous substances, and on the other side water, the solution of sugar will diffuse into the water, and the water into the sugar juice until the liquids on each side of the membrane become of the same density. If the water containing the sugar is then drawn off and fresh water substituted the diffusion will recommence, and this process may be

continued until the whole of the sugar has passed away in the form of a nearly pure solution, while the impurities will remain alone in the solution which was originally sugar juice. In nature the walls of the cells of plants form a diffusing medium. The sugar in the beet exists shut up inside the cells. It was found that it could be extracted in the way described above.

It will now be seen why the factory desires to have sound roots. As a writer in the *International Sugar Journal* says: "Good sound slices can stand the pressure in the cylinder, but soft ones, with no more elasticity in their cells, cannot; and the writer has seen a battery for this reason come to a complete standstill, in which case some tons of slices have to be sacrificed before the work can be restarted. On the other hand, woody beets, beets which have flowered, will cause the knives to choke. Frozen beets, though not a raw material to be favourably looked upon, can be worked up, but frozen beets that have thawed out and are soft and rotten will cause trouble all through the course of manufacture."

Beet Juice and Cane Juice.—The use of diffusion in sugar manufacture began in 1860. Before that the beets were pulped, and then the juice was squeezed out of them, an exceedingly troublesome and sloppy process. As to cane juice, it is obtained by shredding the canes and squeezing them through sets of rollers. There are now nine and twelve roller mills. As the slicing of cane is a much more difficult job than the slicing of beets, the diffusion process has not been conspicuously satisfactory when applied to cane. The treating of cane refuse (megass or bagasse) by diffusion has been successfully tried, however.

Purification by Lime and Carbonic Acid.—The first thing that is done with the "thin juice" is to pump it through the measuring tank. Then the process of purification begins. The "thin juice" is run into vats, where it is mixed with lime. It then looks more like stuff with which to plaster a house than juice out of which sugar is to be obtained. The lime has the effect of causing organic impurities to go to the bottom. The next process is to get rid of the lime. This is done with carbonic acid. One of the chief requirements of a sugar factory, after water, is lime. An enormous quantity is used. It is burnt on the premises, and in the burning the carbonic acid which is needed to get rid of the lime is obtained. The sulphurous acid used in sulphuring, to improve the colour of the sugar, is obtained by burning sulphur.

After the carbonic acid treatment the juice proceeds to the filter presses, where it is forced through, perhaps, fifty layers of canvas. The saturated lime which is deposited is a by-product, which is given to the farmers who supply the beets.*

From Syrup to Crystals.—The "thin juice," again treated with lime and carbonic acid, and once more filtered, is now boiled at as low a temperature as possible in evaporators, out of which the air has been pumped, until it becomes "thick juice," when it can be filtered more thoroughly. Between the boiling to "thick juice" and the filtering is the sulphuring. The boiling to crystals follows. This is done in vacuum pans. The visitor to a factory remarks the skill of the sugar-boiler, who, by means of tests of the liquid on a piece of glass held over a powerful light, arrests the boiling process at the point at which the crystals have grown exactly to the size required.

Eventually the brown boiled stuff, remarkably even in grain, and looking something like toffee at the stage at which the sugar has not quite melted in the cook's pan

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* *See* Chapter XVII.

—it is called massecuite—is let out into the cooling pan from which the centrifugal hydro-extractors are supplied.

Sugar.—In these whirring centrifugals the syrup flies in a few seconds from the massecuite, and the result when cold is the light brown first product, raw sugar, the chief output of many of the Continental beet sugar factories, and the 88 per cent. article of the newspaper market lists. This raw sugar is not consumable.

The syrup which has flown from the massecuite is again drawn into the vacuum pan and boiled. The result is second product raw sugar. Its syrup is molasses, the production of which it is the object of the factory to avoid. In an up-to-date German factory the result of the campaign 1908-9 was:

	Tons.
First product sugar (analysis 90·25)	20,818
Second product sugar (analysis 81·52)	1,805
Molasses	1.806

The prices obtained for first and second products and molasses are stated in the Appendix.

Some factories on the Continent wash their first product in the centrifugal machines, dry it, and call it granulated. But first marks granulated sugars have all undergone some refining process, and consequently fetch higher prices. The blueing of sugar is done almost in the same way as the blueing of clothes in a laundry. When the making of granulated sugar is the factory's object, the second product sugar is not retained, but is dissolved and returned to the "thick juice." The factory produces, therefore, white granulated sugar and molasses only.

A Fallacy of the Kitchen.—It is worth while correcting here a common mistake on the part of housewives. They

Unloading Beets at the Hollandia Factory

Some of the Barges

make great efforts at every jam-preserving to provide themselves with what they call "the best lump sugar." The composition of lump sugar is exactly the same as that of granulated sugar, which they declare will injure their jam. As a matter of fact, no lump sugar is used in jam factories. Lump sugar is merely sugar run into moulds. Icing sugar is the same kind of sugar as granulated or lump sugar, ground fine.

While we like little cubes of sugar for our tea, in Holland and France lump sugar is preferred, not in little cubes, but in little flat oblongs. Visitors to the Continent sometimes say that they prefer this "beet sugar." If they really do, what they like is simply the texture. The sugar itself is no different from that they have at home, except that it is more easily dissolved.

The reason why the lump sugar on our tea-table is regular in size is that it is cut down from big flat squares; the old sugar loaf of the grocers' windows, which, when chopped up, yielded irregular sizes of sugar, has disappeared. When one looks at the complicated machinery used in the tedious, messy, and finger-scorching work of producing sugar loaves, one wonders that they should have survived so long.

The Different Sorts of Sugar.—As to granulated sugar, there used to be a demand, in parts of the country at any rate, for large crystals. Higher prices were paid for them, but, as Dr. Schack-Sommer pointed out some years ago, they are, by reason of the high temperature at which they are made, less soluble than small crystals. Demerara sugar is also esteemed for special sweetening properties which it does not possess. The agreeable flavour is due to the essential oils and "impurities" surviving from the cane. Mr. Martineau, in one of his most interesting chapters—to which every reader who wants to understand in detail the processes of sugar-making will refer—explains that sugar

> may be boiled into large grained yellow crystals, as in Demerara; or into still larger grained sugar, which is afterwards washed white, as in France, or into small grained sugar, afterwards washed white, as is the practice in Germany, Austria, and Russia in making "granulated"; or into a superior crystalline raw sugar for the use of sugar refiners, as in Cuba, Peru, St. Domingo, Java, and other progressive cane sugar countries, and also in most of the beet sugar districts of Europe; but seldom in the United States, where "granulated" is almost universal.

Our sparkling lump sugar is boiled in the pan until the crystals appear and then run into cube moulds (or loaf moulds, as the case may be). The dull lump sugar of the Paris restaurant is made by mixing crystals with a sugar syrup and pressing the mass while it is of a putty-like consistency. Hence the name "press cubes."

The Taste of Sugar.—There is no difference whatever in the taste of refined beet sugar and refined cane sugar. Not a quarter of a century ago, however, it was suggested in a scientific paper that beet sugar had not the sweetening power of cane sugar and that it could not be depended upon for preserving purposes. At a meeting of the Society of Chemical Industry, in 1887, it was clearly demonstrated that while raw cane sugar was "sweet and pleasant" and raw beet sugar was "nauseous," there was "no difference between the refined articles." The members present tasted samples of refined cane sugar and refined beet sugar, and "most of them, in the proportion of four to one, thought that the sample made from cane sugar had been made from beet." There are still misconceptions, however, as to the superiority of cane sugar over beet sugar.*

As some people have begun to take saccharine (a coal-tar product) in their tea and to their food, it may be stated that it is non-assimilable. This is why it is useful for diabetic subjects. It merely gives the sensation of the taste of sugar without the nutrition afforded by sugar. Saccharine passes right through the body. Sugar, as oarsmen know, is a great source of vital energy. Saccharine is considered by many authorities to be the reverse of beneficial.

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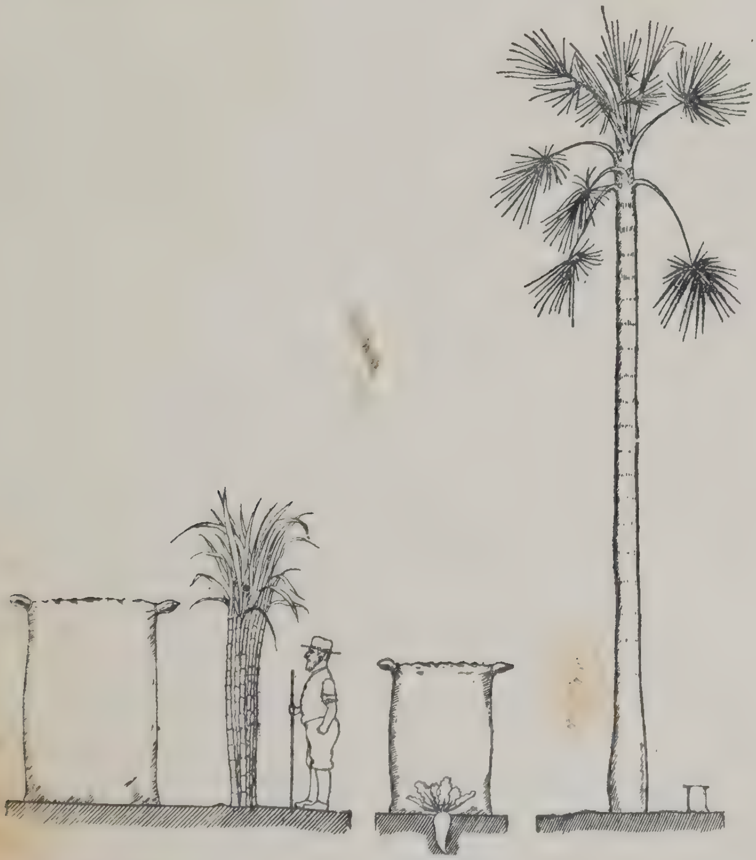
* *See* Appendix.

The Various Sources of Sugar.—The sources from which sugar is derived are various, but crystallised sugar is the same, whatever plant it is drawn from. What give the


7,636,378 TONS.
6,651,000 TONS.
560,000 TONS.

WORLD'S PRODUCTION OF CANE, BEET, AND PALM SUGAR (1908-9) REPRESENTED BY THE SIZES OF THE BAGS.

different flavours to different sugars is their "impurities," their essential oils. When France put up a barrier against West Indian sugar, attempts were made to supply the needs of Napoleon's subjects from mangels, kohl rabi, and salsify, as well as beet. Sugar may be obtained from cereals. A ton of maize stalks, the American *Sugar Beet* says, will give 162lb. of sugar, polarising 96, and 29lb. polarising 89, with 67lb. of molasses. But cereal sugar has not the sweetening power of cane and beet sugars. It is used principally for fermenting purposes. Stress is laid on the inexpensiveness of the crop.

Although in the United States the chief sugar production is from cane and beet, some 11,000 tons are drawn in a year from the sugar maple. There is also melon sugar. In India (where 2,000,000 tons of cane are also produced)* as many as 560,000 tons are yielded by palm trees. But it is cane and beet that provide the world with most of its sugar. The total manufacture was :—

	1908-9.	1909-10.	1910-11.†
Cane . .	7,636,378	8,328,682	8,464,500
Beet . .	6,927,875	6,588,595	8,582,220

Enter the State.—One of the sights of a sugar factory is the great caverns of sugar. From the floors of these caverns the sugar comes down through shoots to be bagged, and there the novice sees something else that is curious. Within a yard or two of the mouth of the shoot, where each bag in turn, resting on a weighing machine, is quickly filled, sits a representative of the State. There are four men from the Excise in a Dutch factory by day and another four by night. Out in the storing warehouse there is a fifth, and at the canal side, where the sugar is shipped, stands a sixth. Only by this rigid scrutiny can the Governments which rely upon a sugar duty for part of their revenue feel easy as to getting their percentage from every hundredweight made No sugar may be moved except in the presence of a representative of the Excise, and it may leave the factory only by a special door marked "Uitgang voor Suiker." The Excise bill is paid weekly. Quite 2¼d. of the 4½d. which the Dutch housewife pays for a pound of sugar represents the manufacturer's payment to the Excise.

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* This is a very rough estimate. (*See* Nöel Paton's excellent "Notes on Sugar in India"). So is that of Palmyra jaggery.

† Willett and Gray's estimate.

By-Products.—A sugar factory, in addition to sugar and the by-product already spoken of, saturated lime, produces beet pulp and molasses. A certain amount of the pulp withdrawn from the diffusers is returned to farmers in a wet state, after pressing, that is, in very much the condition of brewers' grains. But this can only be sold locally, owing to the inconvenience of transportation. It is fed fermented, like sauerkraut. To make a saleable product of the bulk of the pulp it is necessary to dry it. This is a more difficult job than it seems. The exhausted beet slices* are first subjected to heavy pressure. but after this they are still very damp. They have accordingly to be passed through kilns. In the kiln are nine fans in tiers. The pulp passes in, and is whirled round one propeller, then round the next, and then round the next again, and so on round the whole nine. The speed is so great that the pulp is dried, not singed. If one chews a piece of pulp—it looks like dried seaweed—it has at first merely a woody taste, but in a moment or two the sweet and nutritious character of the thing becomes perceptible. The value of this food for cattle is discussed later.

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* Also called "cossettes."

Dutch and Bohemian Factories.—The factory of the Hollandia company at Gorinchem, near Rotterdam, which I have been describing, covers about five acres of land, and, its founder having been a military man, its trimness, cleanliness, and efficient look are noteworthy. All sugar factories are not so tidy. It can use up 60,000 tons of beets in a "campaign."

A beet sugar factory, of which, by the courtesy of Messrs. Breitfeld, Daněk, and Co., of Prague, the makers of the machinery, I am able to give some photographic views, is that of Leopoldsdorf, in Austria, in that great plain formed by the alluvium of the Danube which is so suitable for the cultivation of beet. It was built in 1902 and cost £168,000. The factory, which was first constructed to deal with 600 tons of beet daily, can now handle 1000 tons. The beets, as they arrive by rail or cart, are discharged into immense pits, as shown in one of the illustrations. At the bottom there is a channel for the water which carries the beets into the factory. There is a particularly elaborate apparatus for preventing stones and dirt entering the factory with the beets and playing havoc with the slicers.

A Model Factory.—In the *Sugar Beet* there is a summary of a paper read before the Beet Sugar Manufacturers' Syndicate of France on a model beet sugar factory. The writer says that as in the manufacture of beet sugar the expensive items are labour and fuel, the main problems to solve are those of economising steam and labour and decreasing the sugar losses :

> With this idea in view one should centre one's attention upon simple methods. The factory should be well arranged, having a central hall with two side buildings—in the left one the beet washers,

One of the Electric Cranes at the Hollandia Factory Emptying Beets from Barges

the diffusion battery, and the drying plant for handling the residuary slices should find a place. In the central building should be situated the various machines for handling the juice. There should be an upper central gallery; this enables one to keep under eye the general run of the sugar plant. In the building on the right locate the appliances for working the syrup, massecuite, &c., and the sugar warehouse. Here should be placed also the boilers, the multiple effects, and vacuum pans. Under these conditions the length of the pipes is reduced to a minimum.

Water.—The beets are brought in in well-arranged flumes. These give excellent results when ample water can be obtained. In the hydraulic carrier at certain intervals are placed stone separators, also well-arranged rakes which retain all the floating stems, leaves, &c., on the surface. These, if allowed to remain, would ruin the edges of the slicing blades. For the same reason great advantages are to be derived from the use of shakers and brushes, upon which the roots slide before entering the washer. It is desirable to collect the residuary products and separate the tip ends of broken beets so that they may be returned to the diffusion battery or sent to the slice dryers.

Mr. E. Koppeschaar, after noticing (in the *International Sugar Journal*) that a raw sugar factory consumes 6 per cent. or 8 per cent. of coal and about 5 per cent. of limestone per beet weight, estimates the water requirements of a factory handling 1000 tons of beets a day as: for raw juice, 11 to 12 gals. per cwt. of beets; to be left with wet slices, 100 per cent. beet weight; for condensing, 1100 to 1300 gals. per minute, and for other purposes, another 200 to 450 gals. per minute. The whole of the water used for condensing can be saved by cooling. It was once cooled by being run over a great stack of faggots. Ingenious cooling towers are now employed.

CHAPTER III

HOW BEET SUGAR MAKING BEGAN AND GREW

The First Beet Sugar Factory.—Although in one winter eight million tons of sugar are taken out of beet roots, it was only in 1747 that Marggraf, in a laboratory experiment, procured the first beet sugar.* It was nearly half a century later before a pupil of Marggraf, Francis Carl Achard, found out how to extract sugar from beets on a commercial scale. With the help of Frederick William III. he was able sixteen years before Waterloo, that is, in 1799, to build at Cunern, near Breslau, in Silesia, the first beet sugar factory. It was not equal to producing more than 6 tons of sugar in a season. The little filter press through which this pioneer factory strained its juice is preserved at the Sugar Institute in Berlin. It is about a foot square. At the time the contrivance was devised it was thought to be impossible to make a filter press any bigger. Filter presses may now be seen which are 100ft. long.

How We Induced the Continent to Produce Sugar.—In the early years of beet sugar making the fact that the sugar manufactured by Achard cost 2s. 4d. a pound to make was not in the least discouraging. Sugar was dear then. France could not get sugar because the British admirals had interrupted her Colonial trade. The Continent in general could not obtain it because Napoleon had struck at our rich West Indian trade by prohibiting the importation of sugar into Europe. British West Indian sugar rose in value to anything between £15 and £20 per hundredweight. (It is now not so many shillings.) The West Indies were the largest producers of sugar in the world.

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* In 1705 De Serre had suspected the presence of sugar in the beet root.

No wonder Napoleon and other Continental rulers helped along beet sugar production. Was not beet sugar going to render Europe independent of British cane? The Emperor devoted nearly a quarter of a million acres to beet-growing, and in 1812 he had forty factories to show for his grant of a million francs. He had licences issued for 500 more factories, besides a score of sugar schools. One of the first sugar loaves exhibited in 1811 was produced from beets grown near Paris.

It is curious, indeed, that an industry which we forced on the Continent so long ago should only now be reaching our shores.

After the suppression of Napoleon, beet sugar making fell on less stimulating days, but did not utterly collapse. The low sugar content of the beets of that period and the crude methods of extracting the sugar handicapped the industry in the competition with cane. Nevertheless, as brains were put into the improvement of the beetroot and beet sugar manufacture, the position of the industry was strengthened. By means of various financial ingenuities, State help was also forthcoming for beet sugar. It was too handy a thing to tax not to be cherished by Authority.

A German Achievement.—Germany seems to have been far the wisest of the paternal Governments. She taxed the industry on the assumption that a certain percentage of sugar was obtained per ton of beets. It was obviously to the industry's interest to produce and to grow richer roots than the tax-makers had in contemplation, and by the improvement of factory machinery and processes to extract more and more sugar; and all this was done very thoroughly. France, which was not so wideawake in her excise methods, was soon at a standstill in sugar production, making in 1884 no more sugar than she had done in 1871. On the other hand, Germany, which in 1871 had been 98,000 tons behind France, was in 1884 some 937,000 tons ahead of her. While Germany was extracting 11 per cent. instead of the 8·28 per cent. of sugar she used to get out of her beets, France was still content with 6 per cent. When France woke up and arranged her excise according to the German pattern she very soon got 10 per cent.

In the year before Queen Victoria came to the throne there had been estimated to be in the German States 127 sugar factories. They were tiny affairs, of course, in comparison with the modern factories. They turned out an average of 11 tons of sugar apiece from a total crop of 3250 acres. The yield per cent. of sugar from the beet at this time was only 5½ per cent. (Marggraf had found only from 2 to 3 per cent. in his beets.) By 1907 there were in Germany 1,100,000 acres under beet and 369 factories; the production of sugar averaged about 6000 tons per factory, or some 2 tons per acre; and the sugar in the beets had risen by careful breeding of the plants to 15·7 per cent.

Beet *v.* **Cane.**—No wonder that long before this the humble beetroot had been boldly declared to be the future conqueror of cane, though Liebig had warned German enthusiasts that he set less store than they did on its chances in the struggle with the tropical sugar plant. It is within the lifetime of readers of this book that the beet sugar industry, in the words of one of its historians,

Beets Swimming into the Hollandia Factory

Note the man's ball tined fork

"became self-supporting as it was conducted on more scientific lines." By 1854 the total production was 200,000 tons. In 1864 it was half a million tons. Within seven years more it was more than a million. In the early eighties the world's figure—for beet sugar manufacture had now been started outside Europe, in the United States—was double that. Before long, in Mr. Martineau's words, half and even two-thirds of the visible sugar production of the world (not reckoning the then unknown production of India) was produced not from sugar-cane, but from sugar beet. The present situation is that beet, after having crept past cane, has now been again distanced by the tropical plant. The story of the various fiscal methods taken by the different States to develop the beet sugar industry—and to add to revenue out of it—is extraordinary. It is outlined in Chapter XXII.

The Beet Sugar World.—The industry "was conducted on more scientific lines" in two ways. First, as will be shown in greater detail in Chapter IV., by improvements in the beet itself and in its cultivation; second, by engineering, chemical, and commercial progress. Few English people have any conception of the extent to which money and trained intelligence have been and are now concentrated on improving beet seed and on perfecting the processes of beet sugar manufacture. Sugar schools, sugar chemists, sugar engineers, and sugar journals abound across the North Sea and the Channel.* Beet is practically the pivot of the agricultural system of the Continent, and capital is engaged in the manufacture of beet sugar which would astound Achard and amaze Liebig.

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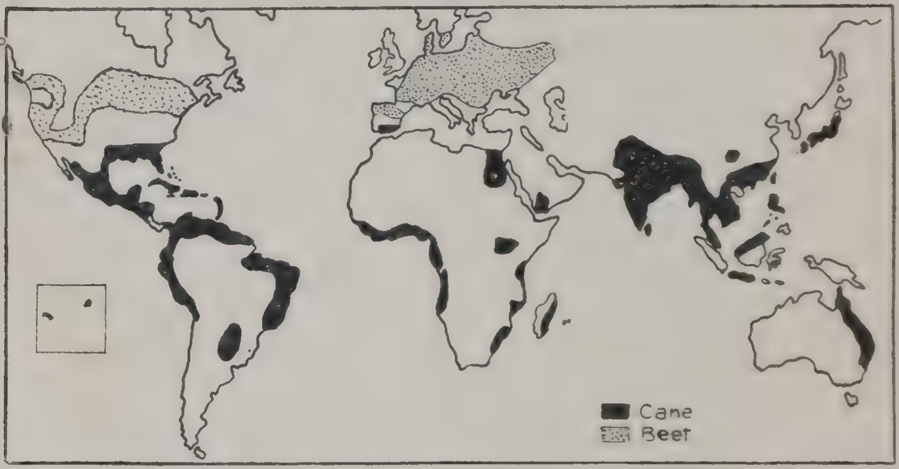
* In the United States courses in beet sugar production are now given in colleges in Michigan, Wisconsin, Colorado, Utah, and California.

The Country which Produces No Beet Sugar.—As far as Great Britain is concerned, the situation is that while Europe, from Sweden in the north to Switzerland in the centre and Greece in the south, produced in 1909 about 6,500,000 tons of beet sugar—the United States and Canada produced some 400,000 tons—Great Britain did not produce a single lump. Norway is the only European country besides ours which does not grow sugar beets. All the sugar we consume—some 1,760,000 tons a year—is imported. Not 300,000 tons of this is cane sugar. Deduct the sugar re-exported after being refined, and our total consumption of beet and cane sugar is 1,600,000 tons. There are another 200,000 tons of molasses.



Where the Sugar Comes From.

Except for the sugar beet grown in the United States (about 457,000 tons) and Canada (about 8,000 tons), the crop is almost peculiar to Europe (6,500,000 tons). A start has been made, however, in N.-E. Asia and elsewhere. Hawaii and Fiji (cane) are inset. The map omits to dot Italy, the Balkan States, and Greece as beet growing countries. *See* map on page 2, and also Appendix.

Our non-manufacture of beet sugar is the more remarkable in that we consume more sugar per head than any country in the world. Striking an average between the tables of the eminent sugar statisticians, Otto Licht and

F. O. Licht, our consumption in 1907-8 seems to have been nearly 91¾lb. per head of the population.*

Why did Beet Sugar Go Ahead ?—Exactly how much of the progress of the beet industry on the Continent has been due to—

(1) The start given by the Napoleonic blockade;

(2) State encouragement;

(3) The opening in the agricultural rotations of the Continent for a root which saved fallowing, increased the possibilities of stock-keeping, and fed the soil and improved its texture and depth with immense benefit to succeeding crops;

(4) The non-possession of sugar Colonies by the great beet sugar countries, Germany and Austria;

(5) The fall in the price of corn;

(6) The increasing demand of expanding populations for sugar,

(7) Scientific education, commercial enterprise, and manufacturing efficiency;

(8) Proximity to market, and

(9) The many other advantages of northern over tropical industry—

the historian of our own times must one day decide.

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* *See* Appendix for latest tables of production and consumption.

CHAPTER IV

HOW "BETA VULGARIS" ROSE IN THE WORLD

Evolution of Sugar Beet.—Modern sugar beets, red table beets, and mangels have all been bred and selected from the wild beet of muddy seashores.

> In appearance and habit (says the Director of Rothamsted) the sugar beet differs but little from the mangel; it is white fleshed and has more of the shape of the Long Red than of the Globe mangel, but it is smaller, grows more deeply in the ground with but little of the bulb exposed, and develops much more fibre on the bulb and root proper than does the mangel. But the main difference between sugar beet and mangel lies in their composition. A process of selecting sugar beet for seed on the basis of their richness in sugar has been going on.*

Whereas the wild beet was what is called a "halophyte," and grew on its seashores in detritus saturated with salt, its descendant, from which sugar is obtained, is a "mesophyte" and flourishes in soils free from salt. This may be one reason, Dr. Briem suggests, why the plant can digest the extremely large applications of nitrate which are applied to it in agricultural practice on the Continent.

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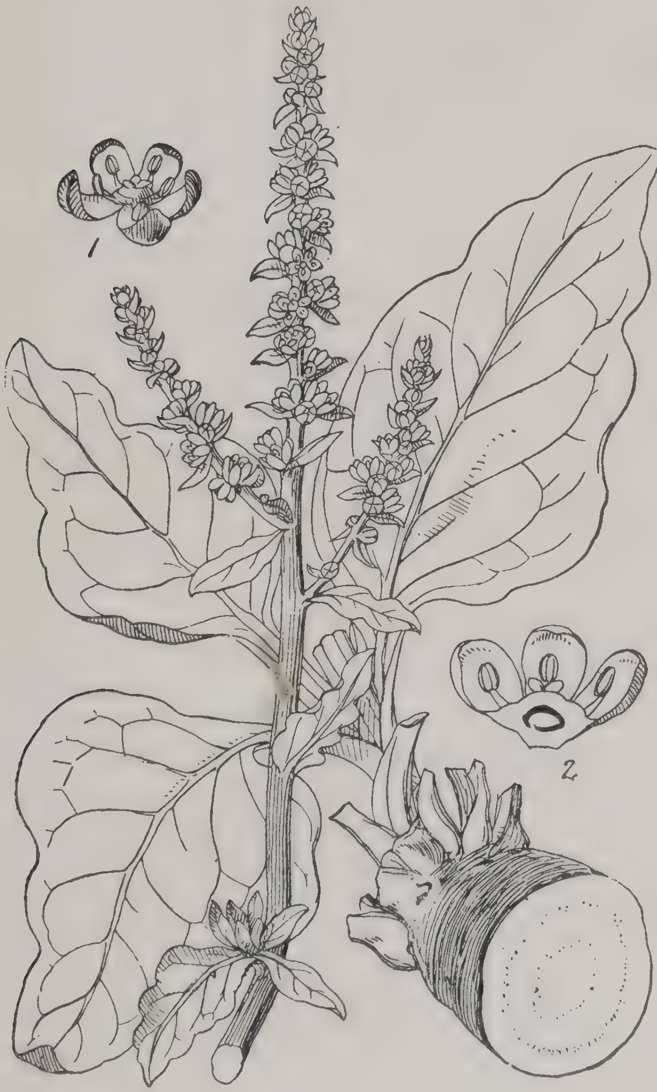
* MANGELS AND SUGAR BEETS.—"The sugar varies from 3 to 4 per cent. in the large Long Red mangels to about 7 or 8 per cent. in the Golden Tankard and well-grown Globes. The water content varies from 86 per cent. in the best kinds to 92 per cent. in the poorer varieties. The water content of a sugar beet is about 82 per cent. The amount of sugar averages 15 or 16 per cent.; the woody fibre about 1·3 per cent."—Percival's "Agricultural Botany."

Indeed, beets have been grown on salty seashore lands in the United States to remove the excess of salt from the soil; and elsewhere, on land which had been inundated, are said to have had a good analysis.



Beta Maritima.
1. Flower. 2. Section of flower enlarged.

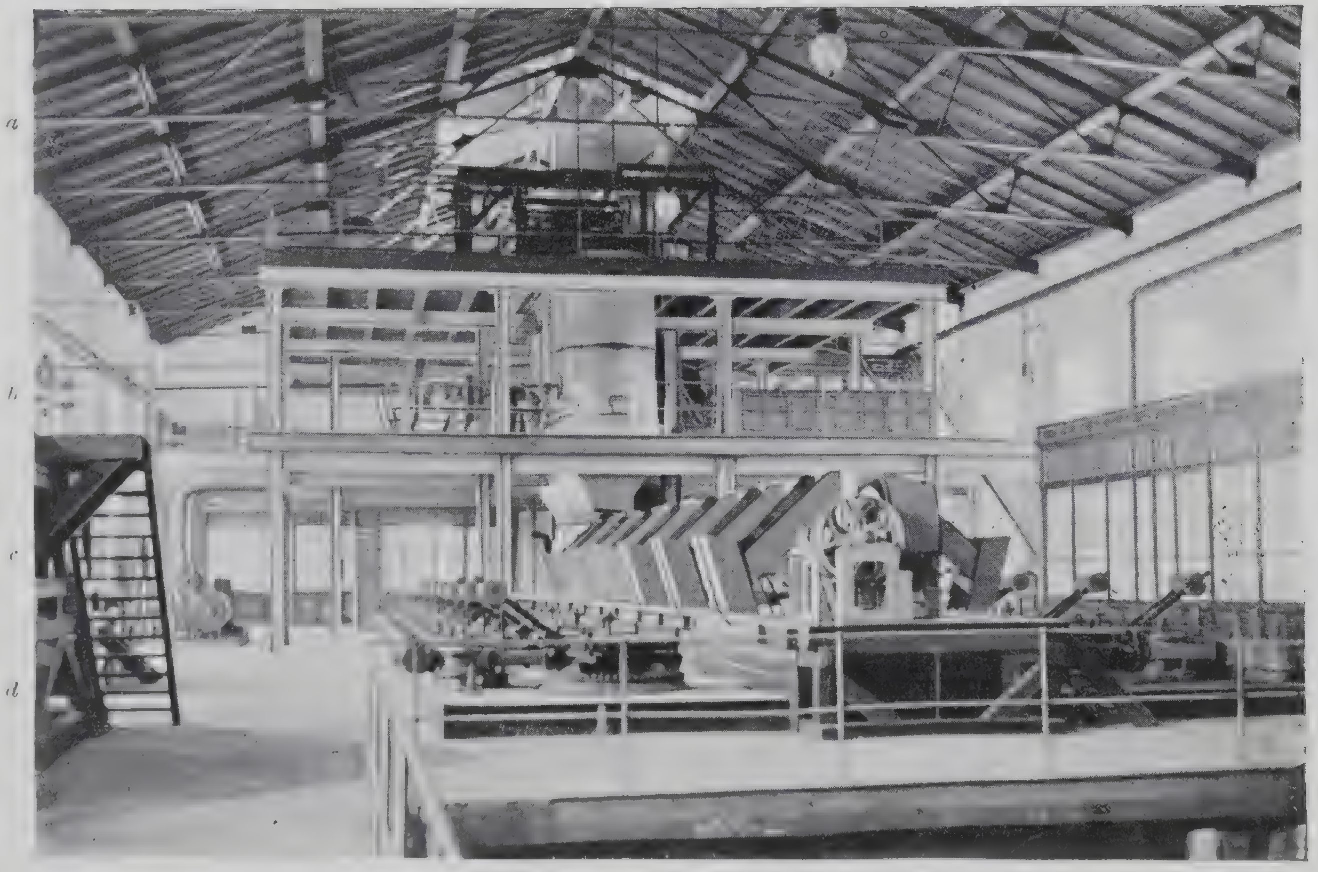
De Vries believes that the white Silesian beet with which the breeders first began to work their marvels in improving the root, had for its ancestors an annual *Beta maritima* and *Beta vulgaris* (biennial).

Problems of Cultivation.—Light is thrown on the origin of the beet by the well-known behaviour of some of the plants in every beet crop. One class of reverters to type ("shooters") flowers in its first year instead of confining itself to the work of root production. The other class ("defiers") will not seed when planted out in its second year for seeding purposes, but defers the performance of this function until the third summer of its life.

The matter has a practical importance for the farmer beet-grower, because flowering beets naturally contain less sugar than normal roots. Some factories require that they shall be pulled out of the growing crop or simply refuse to accept them.

In growing beet for the manufacture of sugar (Mr. A. D. Hall goes on to explain) the composition of the roots is all-important; the extraction processes are only economical when the roots contain a high proportion of sugar and are as free as possible from the non-crystallisable sugars and other non-soluble bodies. In consequence, most factories not only pay for their roots on a scale varying with the proportion of sugar they contain, but will entirely reject consignments of roots which fall below a certain standard. The necessity of maintaining a high proportion of sugar and of purity means a certain restriction of yield; heavy crops of big roots grown by the use of large quantities of manure such as are used in this country for the management of the mangels mean roots that are deficient in purity.

At the start, the beet-breeders were chiefly stimulated by the fact that in several countries the factories received from their Governments a bonus on the sugar produced per ton of beets. As, however, the farmer was often paid by the weight of beets, not by the sugar they contained,



THE TOP STOREY OF THE LEOPOLDSDORF SUGAR FACTORY

The beets are drawn up from the basement by a lift, which is not shown

(*a*) Machine in which beets are weighed. (*b*) Apparatus in which they are sliced. (*c*) Shoots down which they fall into the diffusers. The ends of the shoots are canted up. (*d*) The diffusers (closed lids only showing). They are tall vertical cylinders, the bottoms of which—whence the slices are taken out—are shown in another illustration he cared for none of these things, and would sometimes discard the high sugar percentage seed supplied to him by the factory and sow some heavy cropping sort of his own instead.

> But (Mr. Koppeschaar says) when the greater part of the fiscal protection was rescinded and more assistance was forthcoming—such as agricultural education given by State teachers—and a system of co-operation was evolved, the farmers tended more and more to complete contracts based on percentage of sugar in roots, and factories began to spring up run on co-operative lines; so that the conditions entirely changed, and the seed most in demand was now that which would produce a beet rich in sugar (though not of the highest) and give a fair but not abnormal yield. This ensured a reasonable yield of sugar per acre while avoiding too great a bulk of roots to be worked up; it also restricted the amount of plant food, fertiliser, &c., required to the acre. It may be remembered that mangels give the highest yield of sugar per acre, but absorb a commensurate amount of plant food and represent a tremendous bulk to handle.*

But disposing of the seed supplied by the factory and sowing what is considered to be more satisfactory is still practised now and then by Continental peasants. Occasionally, when there has been a bad season for seed, the factory seed may be worth £4 a bag. Some factories protect themselves by mixing a little cattle beet seed with the sugar beet seed, and their inspectors, when they visit the farmers' crops, know, if they see some of this forage beet growing, that the seed supplied has actually been sown.

The First Improvement in Beets.—Before the use of the polariscope the improvement of beets could be carried on by selecting roots by appearance and specific weight, and by employing the rough alcohol test for sugar. The plan was to clamp the roots after harvest and during the winter to analyse them. A piece was bored out of likely roots by an instrument like a cheese-taster. The beets which by analysis showed themselves exceptional were planted out in the spring. They did not suffer in any way by the testing process. The planted-out roots, now in their second year, flowered, and the seed was saved In the third year the seed was sown. The best of the roots produced from this seed were saved through the winter. They were analysed in their turn, and the superior ones were planted the next year for seed. It was this seed which was put on the market for the beet-grower. The selection of seed beets by specific weight was done by washing them and then testing them in salted water, Those that sank were planted and those that did not were given to cattle. But the polariscope was certainly in use by Vilmorin and others forty or fifty years ago.

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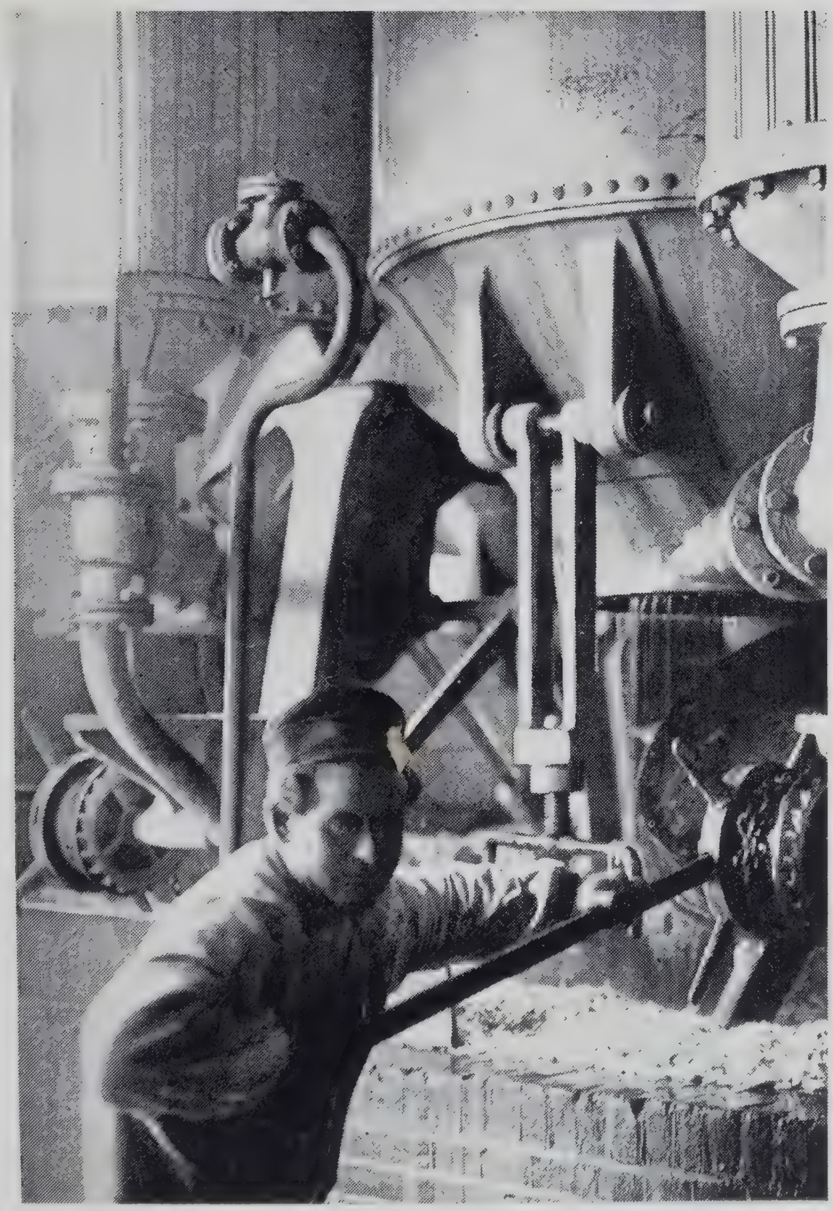
* *International Sugar Journal*, Altrincham.

Modern Methods.—During the last half century many firms in Germany, Austria, Holland, and elsewhere have gained distinction by their labours in raising the sugar content of beet, and by introducing varieties suited to different agricultural—and fiscal—requirements. Beets rich in sugar are of the early maturing type. They do well on rich soil. Heavy cropping beets are for inferior soils and mature towards the end of the season. The possibility of growing beets maturing at different dates has an obvious bearing on factory deliveries.

The work of breeders nowadays is done by family selection, by the splitting-up of roots, which will be described in a moment, and by the isolation of seed bearers from the possibility of cross-fertilisation. The splitting-up of roots is due to the discovery that "mother beets" may



Releasing the Slices from a Diffuser
Hollandia Factory

not only be bored into with impunity, as explained, but be cut into sections, as potato breeders cut up their tubers. The treatment of the beets is thus explained by Mr. Koppeschaar:

> Mother beets are taken into a hothouse in spring, and as soon as they have enough root hairs they are split up, say, into ten sections. These pieces are cultivated in pots, and when the wound is healed are planted out. With few exceptions they will develop the same year into full-grown seed bearers. Thus from one beet ten seed plants may be obtained.
>
> The selection is extended and perfected, inasmuch as the beets selected to become seed bearers, so-called heads of families, after being split up are kept separate on special plots and their offspring controlled with respect to desired qualities. Beginning with 350 beets selected in the old way, these are all split up into ten pieces, and go to form 350 groups of ten seed bearers. In the seed year 100 groups are eliminated, on account of bad qualities (defective seed production, &c.). The seed of the remaining 250 heads of families (2500 plants) is sown out, each group being kept separate. The ensuing growth is carefully examined as to yield and sugar per cent. The best families (six or eight) are chosen for "superfine" brands, the next twenty for "superior" ones, while the rest are rejected and serve as cattle fodder.
>
> The selected plants are stored over winter. From the six or eight "superfine" families, the best ones are chosen next spring to serve as new heads of families; from each family head, eight or more specimens, weighing at least 600 grams each, will be taken, so that sixty or seventy new heads of families will be obtained.
>
> Another portion of these "superfine" families goes to form "superior" beets, then "thinlings,"* which in their turn produce the seed for marketing. The rest serve as fodder. From the twenty "superior" families 160 family heads are carefully chosen, the rest are used as fodder. We hence have 160 + 60 = 220 "superior" family heads, or 130 short with which to form 350 fresh family heads, future seed bearers. To begin anew, the balance of 130 are obtained by

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* Called also "stecklings."

what is called wild selection, being derived from a self-sown field of 20 acres by analysing about 80,000 beets grown therein.*

At Klein-Wanzleben the field experiments are made on two separate estates with different soils. As the sample beets are taken at the rate of from 100 to 300 from a series of plots which may number anything between 2000 and 2500, the number of beets handled must be something not far short of half a million. Inside the establishment the beets are automatically ejected from the wash-tub in which they are cleansed, are trimmed by machines, are freed from their epidermis and spots by a machine with a steel brush, and are then rasped by a special contrivance. The beets are brought into the main laboratory by classes from a room with compartments specially arranged for accommodating these different classes. In the main laboratory there are ten electrically driven beet boring machines. By the side of each boring machine is a wooden stand holding 200 beets at a time. Each stand contains twenty numbered boxes for ten beets each. In the polarisation room there are ten polariscopes.

Results.—As Dr. Briem, of the well-known Wohanka beet-breeding establishment at Prague, says, the success that has resulted from this new method of pedigree breeding, based on researches into plant physiology, biology, and histology, and on preceding morphological and chemical work, could hardly have been dreamed of. Statistics of the Breslau Chemico-Agricultural Experiment Station show that the sugar content of latter-day beet even in unfavourable weather conditions, will hardly ever go below 15 per cent. or 16 per cent., and that "in favourable soil and weather conditions the harvest of beets containing from

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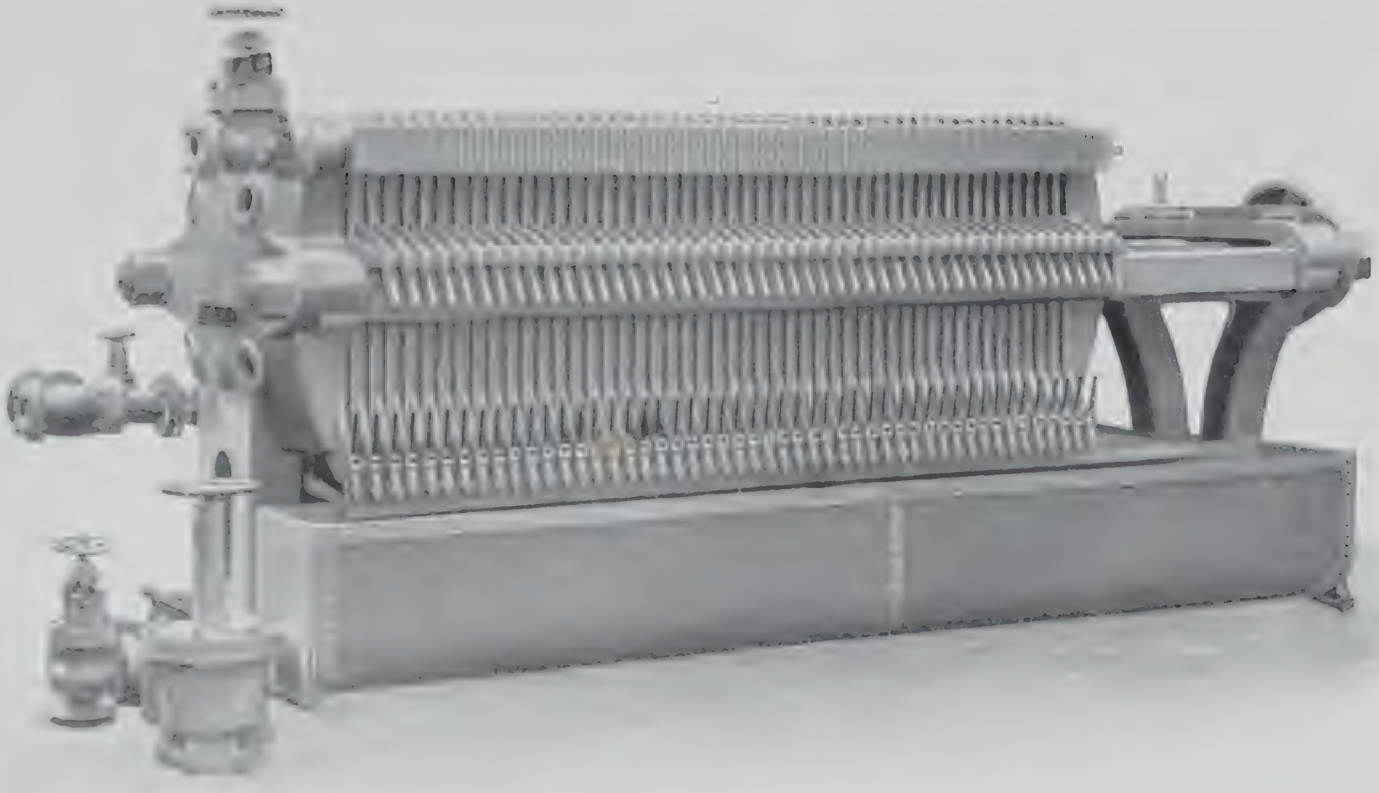
* *International Sugar Journal.*



Filter Press, a section of which is shown on another page
There is a row of filter presses in each factory

16 per cent. to 21 per cent. of sugar has amounted to more than 90 per cent. of the total."

At the seed-growing establishments the seed beets are clamped and brought out for examination and analysis in January before planting in the spring. They lose about 1 per cent. of sugar while stored away, but, even allowing for that, the following Wohanka figures are noteworthy:

				Per cent.
1907—10 per cent. of 130,000	seed beets	analysed	yielded over	19
1908—53 per cent. of 103,000	,,	,,	,,	19
1909—89 per cent. of 60,000	,,	,,	,,	19

In other words, the percentage of high sugar content beets increases.

An illustration may be given of sugar content in a beet family. Two scions, or super beets, were registered in the 1906 harvest. In the spring of 1907 No. 1 showed 19·8 per cent. of sugar, and No. 2 as much as 20·6 per cent. The seed grown from these scions in 1907 was sown in 1908, and the produce harvested. There were ninety beets descended from No. 1 and eighty-five from No. 2. When these were tested in the spring of 1909 they were found to have sugar contents as follows:

No. 1 Descent.					No. 2 Descent.				
6	had	19-20	per cent.	of sugar.	5	had	19-20	per cent.	of sugar.
32	,,	20-21	,,	,,	34	,,	20-21	,,	,,
43	,,	21-22	,,	,,	39	,,	21-22	,,	,,
9	,,	22-23	,,	,,	7	,,	22-23	,,	,,

Thus the average sugar content of the progeny of the scions was: No. 1, 21·37 per cent. of sugar, and from No. 2, 21·1 per cent. The prepotency of the scions was therefore established, and also the fact that among these two families of beets there were no low sugar content beets, but instead a tendency towards higher content sugar beets.

The process through which beets and beet seeds go before beet seed reaches the farmer may be shown clearly as follows: In

1903, the seed is selected which, in
1904, is sown. This yields, in
1905, the beets from which, in
1906, seed is harvested. This, in
1907, yields the beets which, in
1908, produce the seed, which, in
1909, yields the beets from which, in
1910, the seed is grown to be supplied to farmers for their crops of beet for the factories in
1911.

This is, it will be seen, eight years' work for the seed-breeder independently of the breeding of his scion-seed beet planted in 1903.

It is, of course, imperative that beet seed shall be grown in districts well isolated from the possibilies of foreign pollination. Some German beet-breeders have been buying up all the peasants' bees and sending them to other provinces. The crop is not one for novices.

The Beet of the Future.—The attention of the beet-breeder is steadily given to the problem of enabling the beet to store up the remarkable amount of sugar it now contains and yet remain robust, and to increase the power of the parent plant to transmit its characteristics to its progeny so vigorously that it may be able to do reasonably well under "anti-genial" conditions in regard to soil, season, and change of environment. Discussing the beet of the future the author of "Sugar Beet and Beet Sugar" (*Beet Sugar Gazette* Co., Chicago) says:

> We know that in 1872-3 the sugar percentage extracted from beets in France was 5·70, and in Germany it was 7·93 for the year 1866-7. At present all sugar factories reject beets with less than 12 per cent.

sugar, beets with a sugar content of from 14 to 18 are common, and some factories are cutting beets some of which have from 18 to 20 per cent. sucrose. Even beets with a sugar percentage of from 20 to 25 are by no means very rare. Thus, the sugar percentage of the beets was trebled and can be said to have increased from 1 to 2 per cent. per each decade. At the same time the purity rose from 65 to 75 in the beets of olden times to as much as 80 to 90 in the beets of to-day.

If the improvement of the beet continues—which is reasonable to assume—we may expect that in half a century the sugar beet will have, say, an average sugar percentage of 20 and a corresponding high purity. This is by no means out of the question.

After the harvest of 1908 the director of the laboratory of the Austrian central association of beet sugar manufacturers reported that two samples of beet from Wohanka gave the following analysis :*

No. 1.	No. 2.
27·1 per cent. Balling, 25·08 per cent. sugar, 92·05 purity.	24·71 per cent. sugar, 92·60 purity.
Hot-water digestion, 22·40 per cent. sugar in beet.	22·30 sugar in beet.
After Clerget, 22·46 sugar in beet.	22·09 sugar in beet.

The owners of the beets say that "many of the individual samples tested as high as 25 per cent. and 26 per cent. sugar in beet."

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* "Balling" (or "Brix") is the density. The scale professes to indicate by its figures the total dry substance in solution. The "purity" is the sugar per cent. of total dry substance. "Hot-water digestion" is a usual method of preparing a solution of the sugar contents of the beet for optical determination of its sucrose. Grated beet is mixed with water and placed in a hot-water bath. "After Clerget" means determination by polarisation before and after inversion.

CHAPTER V

THE FIRST FACTORIES AND APOSTLES IN ENGLAND

The Buscot Experiment.—A beet-growing experiment was made in Surrey in the last years of William IV.'s reign.* The next was in Ireland in 1853. Experiments seem to have been going on at intervals ever since. As to articles and letters on the subject, it would take a whole library of scrap-books to hold them. A sugar factory was started near Lavenham Station, Suffolk, in 1870. An experiment made by a Mr. Campbell at Buscot (the present seat of Sir Alexander Henderson), in Oxfordshire, had for its object the utilisation of the roots in distilling. The beets were produced as successfully in

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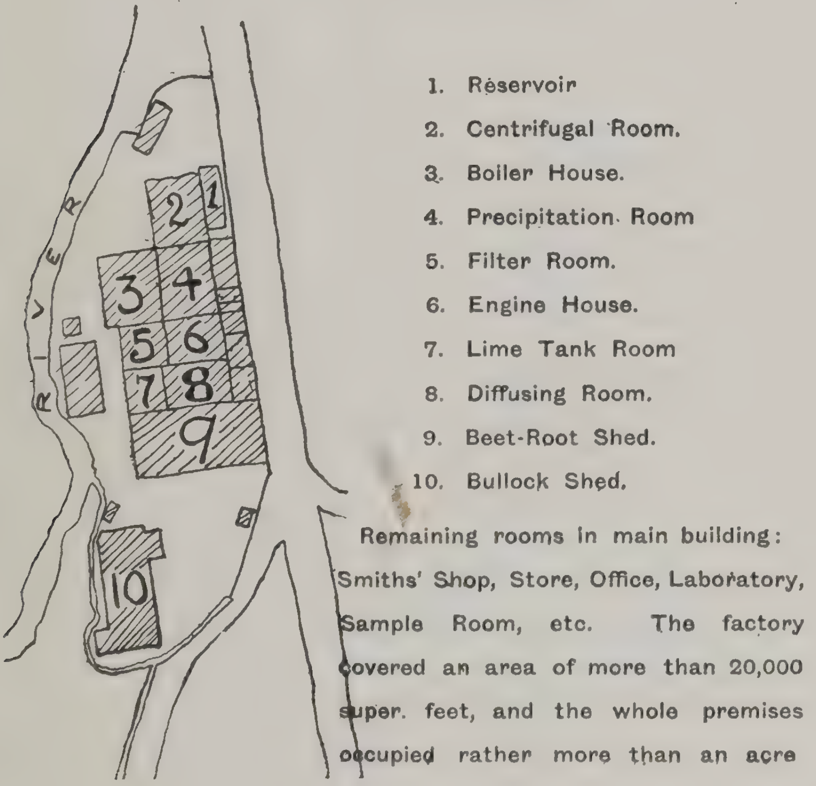
* "It is only England that takes no interest in the production of home-grown sugar. A question was put in that country one day to the Home Secretary as to what he would do if home-grown sugar were to make as much progress in England as it does in France. 'I would at once take steps,' he replied, 'to tear up the English crop to the very last root; for with us it is impossible to conceive of such a chimerical wealth as would arise from producing two things which would destroy each other.'"—*Bulletin des Sucres*, 1837.

"The manufacture of beetroot sugar begins to make great progress in various agricultural districts in Europe. Even in England, in spite of the high price of cattle food and of labour, they were about to introduce the cultivation on a large scale, but the Colonial interests prevailed against them."—*Ibid.*, 1838.

Oxfordshire as in Suffolk. In regard to this experiment, a correspondent well acquainted with it writes to me :

> It entailed an enormous outlay, and had to be given up, one reason being that the excise duties were so heavy as to make the production of spirit prohibitive. The works were in existence for some ten years.


RIVER
1
2
3
4
5
6
7
8
9
10
1. Reservoir
2. Centrifugal Room.
3. Boiler House.
4. Precipitation Room
5. Filter Room.
6. Engine House.
7. Lime Tank Room
8. Diffusing Room.
9. Beet-Root Shed.
10. Bullock Shed.
Remaining rooms in main building:
Smiths' Shop, Store, Office, Laboratory,
Sample Room, etc. The factory
covered an area of more than 20,000
super. feet, and the whole premises
occupied rather more than an acre

Plan of Lavenham Factory.

Another correspondent comments as follows on this statement :

> It was alcohol, not sugar, that Mr. Campbell aimed at, and he did it in fine style. We none of us knew quite why he failed. Amateur high farming does not always result in profits. Also, no one can be sure of success by embarking in the spirit industry in this country.

It is rather a close borough. We know, I think, that he grew roots very big with not much sugar in them. It is nonsense to talk about high excise duty making "the production of spirit prohibitive." That duty is paid by the consumer, and the distiller is protected against foreign competition by a duty higher than the excise.

One who saw the beet growing in 1873 says there were 1600 acres of it. The spirit made in the distillery was exported to France at 2s. 6d. per gallon. Large numbers of cattle were fed on the beet pulp. There were experiments at Buscot in deep cultivation and in irrigation as well as in beet-growing.

The Lavenham Factory.—Technical, labour, and agricultural difficulties all had their share in the death of the first English and Irish beet factories.* Foreign labour seems to have had a good deal to do with the shipwrecking of Irish beet-growing. At Lavenham nails were found among the beets, "sometimes every week." James Duncan, "the greatest British refiner in the sixties and seventies," as Mr. Martineau says, paid 20s. a ton for beets and treated the farmers well, but I have heard that they grumbled at not being paid for the dirt that stuck to the roots; the full supply of beets was not forthcoming; local authorities began to complain about odoriferous waste water—always somewhat of a problem for a beet sugar factory—and so an experiment in the making of which great public spirit had been displayed came to an end. Mr. Martineau says:

James Duncan was an intimate friend, and I had opportunities of visiting not only the factory but the farmers. There was no failure; the experiment was quite successful, but the farmers did not grow enough roots to keep the factory at full work. They were well satisfied with their crops and roots, and Mr. Duncan found them quite as rich as those grown on the Continent. The farmers were quite keen on the new venture, but somehow the roots did not come in as plentifully as Duncan hoped. Then objections were raised by the local authorities in regard to the disposal of the waste waters of the factory, so at last he decided to discontinue the experiments. Then came the bounties; he had quite enough to do fighting them, and certainly did not desire to enter upon any further unequal competition.

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* The first Irish factory was that at Mountmellick, Queen's County, started in 1850. It was reported by a Government official that "the quality of sugar in Irish-grown beet is in no way inferior to that usually found in the best roots on the Continent."

Mr. Duncan's Own Story.—By the courtesy of Dr. G. Schack-Sommer I have been allowed to read a letter written by Mr. Duncan, dated September 29, 1897 (his experiment at Lavenham lasted for about nine years from 1867–8), in the course of which he says:

> The chief reason for my abandoning Lavenham was the scarcity of roots. I never obtained more than 8000 tons. I offered to continue if the farmers would guarantee 20,000 tons, but they could only come up to about 9000 or 10,000. The great difficulty at Lavenham was the insufficient horse-power to move such a large tonnage from the farms to the factory. I put on a traction engine, and this helped; the last season the railway company reduced the rates, and this increased the area. You are aware the land at Lavenham is heavy, and this made traction more difficult. As regards the bounty, at the time the influence had not been felt; the price of sugar was high. There was some trouble about the river; it was as black as ink for miles, partly caused by char water, but chiefly from the escape of rootlets of sugar beet. Subsiding ponds should be erected, and the clear effluent run off only.
>
> My reason for selecting Lavenham after careful looking round was cheap land, a good deal of it farmed by the owners, who could do as they liked. At that time many districts had not the power to sell roots off the land. The roots I also found were of good quality. The chief objection to Lavenham is that most of the land is heavy. In a dry season all goes well, but in a wet autumn the transport is very serious.
>
> After very exhaustive experiments I had come to the conclusion the east of England and the east of Ireland were the districts best suited for the production of high-class roots. Since then my opinion has

been modified. I now believe the area suitable to grow good roots is much larger. Of course, now we have more experience the seed is better, the cultivation is better understood; the action of nitrate has quite revolutionised the industry. Twenty years ago one was accustomed to see on the Continent large patches of bare ground; now hardly a single root is missing. Nitrate has worked wonders with the sugar beet.

Of course, the situation is very different now. The average percentage of sugar n the beets grown in East Anglia has risen, through the improvement of the roots by breeding, from 9 per cent. in the Lavenham days to 17 and 18 and even 19 per cent.; nitrate is in common use; and the processes by which the sugar is extracted from the beets in the factories have been so much bettered that a first-class factory has extracted 16·64 per cent. of the 17·10 per cent. of sugar in its roots. But the human factor has still to be taken account of.

A Half Factory.—It should be noted that the Lavenham machinery was erected merely for the purpose of extracting the juice, clarifying it, and boiling it down sufficiently to enable it to be carried off to the refinery at Clyde Wharf, Victoria Docks. Therefore the Lavenham factory was less than half a factory. Mr. B. E. R. Newlands, who was associated with Mr. Duncan, and remembers discussing the prospects of beet sugar factories with him a week before he died, is good enough to send me the following information:

At the factory, which was worked before the introduction of the diffusion process, the roots were rasped to a pulp, and placed in bags. the juice being expressed by hydraulic power. The latter was treated with lime and carbonic acid passed through a filter press and then over a small quantity of animal charcoal in the usual way, then boiled up to a thick syrup of 40° Beaume, and sent in rum or wine puncheons to the refinery at Victoria Docks, where it was boiled into sugar, without being kept distinct from other sugar undergoing the process of refining.

Where the First Beets to be Grown in Commercial Conditions in England were dealt with. Mr. James Duncan's Factory at Lavenham.

The juice was transported to London, where it was mixed with raw sugar liquor, and made into sugar

Last Days at Lavenham.—When James Duncan disposed of the factory it was bought by the late Colonel Sir Francis Bolton, and the second Lavenham experiment began under the auspices of a company:

> It was a company (one who was at the inaugural banquet at Bury St. Edmunds writes to me) which came out with a great flourish of trumpets, a grand lunch, and a gathering of scientific great guns—the late Lord, then Sir Lyon, Playfair among them—who knew nothing about the industry. The promoters were owners of strontia mines, so the company was to clarify and refine beetroot juice with strontia. The experiment failed, and I suppose the shareholders lost their money. So much for the blessings of men of science when they dabble in subjects they do not understand.

Mr. Alfred Turner, of Lavenham, kindly furnishes me with the later history of the first sugar factory in England:

> It was bought by Messrs. Roper and Sons, manufacturers of matting and horsehair seating. This firm sold the machinery five or six years ago to a German firm.* Then they used it for a store. It then came to grief by being burnt out. It was repaired, a new roof was placed upon it, and it is again now used as a store by Messrs. Roper and Sons. I have seen no beet grown in the neighbourhood since the factory was closed.

Some other Apostles of Beet Sugar.—I may here refer to Mr. Martineau's efforts to interest the agricultural world in the subject of home-grown sugar which were made in the early seventies. Mr. Martineau, whose family has had a century's association with the sugar industry, began with a complete tour of the European beetroot districts, accompanied by a chemist, an engineer, and an Indian sugar-planter, who had already adopted the diffusion process.

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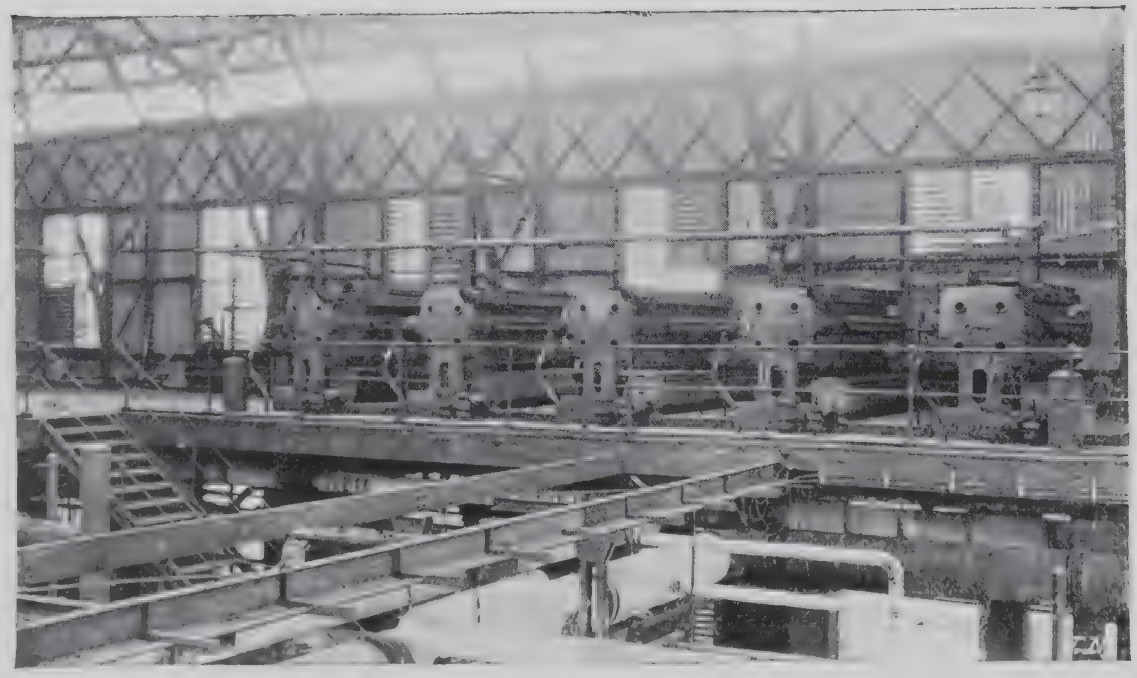
* It was valued in the prospectus of the auction at only £5000. Before the sale, in 1891, Dr. Schack-Sommer had tentatively offered Messrs. Roper and Sons £500 a year for an experimental campaign.

They visited not only sugar factories but also the principal sugar machinery makers, who at that time were full of work in equipping new factories and modernising old ones. The party finished up its tour with a visit to Julius Robert, at Séelowitz, in Moravia, the inventor of the diffusion process. This tour, and the knowledge of what his friend Mr. Duncan was doing at Lavenham, stimulated Mr Martineau.

He found an energetic co-operator in Mr. John Algernon Clarke, who was then a leading man in the agricultural world, wrote agricultural articles for the *Times*, and was secretary to the Central Chamber of Agriculture and editor of its journal. He was also a practical and skilful farmer at Long Sutton, in Lincolnshire. He went into the whole subject and satisfied himself by practical trials that a crop of excellent quality could be grown and at a good profit. The details were published by him in the journal of the Central Chamber of Agriculture, and were reprinted. Many meetings of Lincolnshire farmers were held, but a profit of £3 an acre did not seem to tempt them.

Sir Walter James, of Betteshanger, near Sandwich, was also keen on the subject, and consulted Mr. Martineau as to the details. The land in East Kent is of remarkably fine quality, and no doubt the industry could have had an excellent send-off if started either there or in Lincolnshire. The East Kent farmers were more interested than those in Lincolnshire, and things looked promising. Encouraging meetings were held, the roots were analysed and gave good results, and the weight per acre was most satisfactory. But then came the bounties, the British Sugar Refiners' Committee was appointed in 1872, and Mr. Martineau, as its secretary, had to turn his mind to the thirty years' struggle which culminated in the Brussels Convention.



Row of Filter Presses at the Leopoldsdorf Factory

In later years his friend, Dr. Gustaf Schack-Sommer, a sugar refiner in Liverpool, took up the subject, and in a series of systematic experiments in various parts of the country, initiated in 1889 and carried on during seven consecutive years, demonstrated the possibilities of successfully cultivating sugar beet in England. To some extent this work has been continued by Mr. Sigmund Stein, who acted as Dr. Schack-Sommer's assistant during some of his experiments.

Since the abolition of the bounties, in 1903, no one has done more than Mr. Martineau to call attention to the fact that, while Europe produces more than half the "visible sugar" consumed in the world, Great Britain, the largest consumer, is almost the only European country which makes no attempt to obtain home-grown sugar. Mr. Martineau's letters to the press have been particularly valuable because he has never written about the advantages of sugar beet growing without dwelling on the difficulties in the way of a new crop and industry in England.

In the Eastern Counties note may be taken of the pioneer work done by Mr. F. W. Mason long before the attempt to establish the Sleaford factory referred to in the next chapter. One of the most serviceable contributions to the discussion of the sugar beet question was the paper read by Mr. A. D. Hall before the British Association in 1900, and published in the *Journal* of the South-Eastern Agricultural College at Wye, of which he was then Principal.

The energetic efforts put forth during a considerable period by the Earl of Denbigh are within everyone's knowledge. Some account of his work is given in the next Chapter.

CHAPTER VI

THE YEARS OF THE PROSPECTUSES

The Sleaford Enterprise.—It was not until 1909 that there was a prospect of a factory. In November of that year the prospectus of the Lincolnshire Beet Sugar Company came out. It bore a number of influential local names.* The factory was to be at Sleaford, and was to have been in working order in the autumn of 1910. The capital was £130,000. Contracts were made with 264 farmers for 1980 acres of beet, and it was "fully expected to obtain contracts for a further 500 to 1000 acres." The capital was to be apportioned as follows:

Buildings	£24,359
Machinery	58,900
Constructional ironwork	4,450
Unskilled labour	1,000
Roads at £3 10s. per yard run	1,925
Railway sidings	3,000
Land	2,460
Formation expenses	9,000
Molasses tank and contingencies	6,000
Working capital	18,900
	£130,000

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* The directors were Messrs. A. L. Jessopp, B. P Coulson. A. W. Dear, W. V. R. Fane, F. W. Mason, W. H. Watson, and W. S. White. Mr. Mason had for years been making himself acquainted with the subject and had sent his son to Germany to go through a course of training.

The expert consulted, Mr. Naegelé, made the following "estimates of the results you may reasonably obtain," supposing a crop of "34,000 tons of roots produce 2000 acres, at 17 tons per acre":

Cr.

	£	s.	d.
3604 tons granulated sugar, at £12 ...	43,248	0	0
3704 tons beet slices, at £5 10s.	20,570	0	0
272 tons molasses, at £3 15s.	1,020	0	0
	£64,838	0	0

Dr.

	£	s.	d.
34,000 tons beet delivered to factory, at 17s. 6d.	29,750	0	0
Manufacturing and other expenses, at 7s. 6d.	12,750	0	0
Depreciation—10 per cent. on machinery, 5 per cent. on buildings and constructional ironwork	1,472	10	0
Balance for profit	14,975	10	0
	£64,838	0	0

The following was an "estimate of the profit on the basis of a further 500 acres being obtained":

Cr.

	£	s.	d.
4505 tons sugar, at £12	54,060	0	0
4675 tons slices, at £5 10s.	25,712	10	0
340 tons molasses, at £3 15s.	1,275	0	0
	£81,047	10	0

Dr.

	£	s.	d.
44,250 tons roots, at 17s. 6d.	37,187	10	0
Manufacturing and other expenses, at 7s. 6d.	15,937	10	0
Depreciation—10 per cent. on machinery, 5 per cent. on buildings and constructional ironwork	1,472	10	0
Balance for profit	20,560	0	0
	£81,047	10	0

It will be noticed that the estimates show a profit on a capital of £130,000 of upwards of 11 per cent. for 2000 acres and of 15 per cent. for 2500 acres.*

On the question of labour Mr. Naegelé wrote: "The balance is in favour of Germany, but the difference is not enough to be of importance." Coal was "dearer in Germany and of inferior quality to English." Limestone, it was suggested, was often dearer in Germany than it was likely to be at Sleaford.

The price of refined sugar was taken at £12 per ton in view of "current market price of £13 f.o.b. Hamburg." No English excise duty was allowed for. Beet slices were estimated at £5 10s., against £6 10s. in Germany. It was suggested that the factory would be "equal to the most modern German factories." The capacity was 500 tons of beets per twenty-four hours, "which would amount to about 50,000 tons in the season." The dividends of German sugar factories were put at from "12 to 15 per cent. in many cases." The directors were satisfied that as good or even a better percentage of sugar could be obtained and a greater weight of roots per acre could be produced than in many parts of Germany.

After £64,000 had been subscribed to this company, no more capital seemed forthcoming—the project is said to have suffered during the election through an unfortunate suggestion that the future of beet growing was dependent on the success of a particular party—and the scheme went no farther.

Anglo-Dutch Proposals.—(1) MALDON.—The next stage in the history of beet sugar in England was the announcement, early in 1910, of a plan for an Anglo-Dutch factory

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* These figures and the estimates on which they are based are discussed in later Chapter [illegible]

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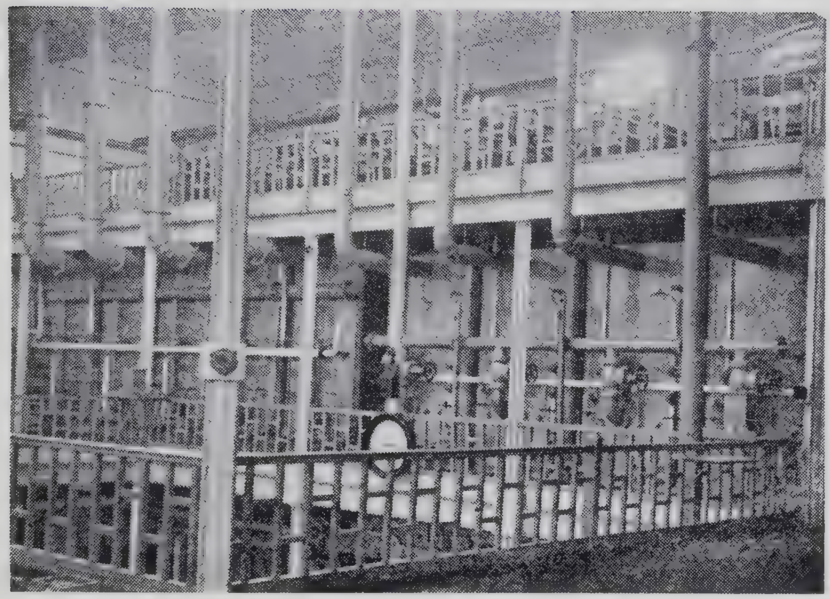
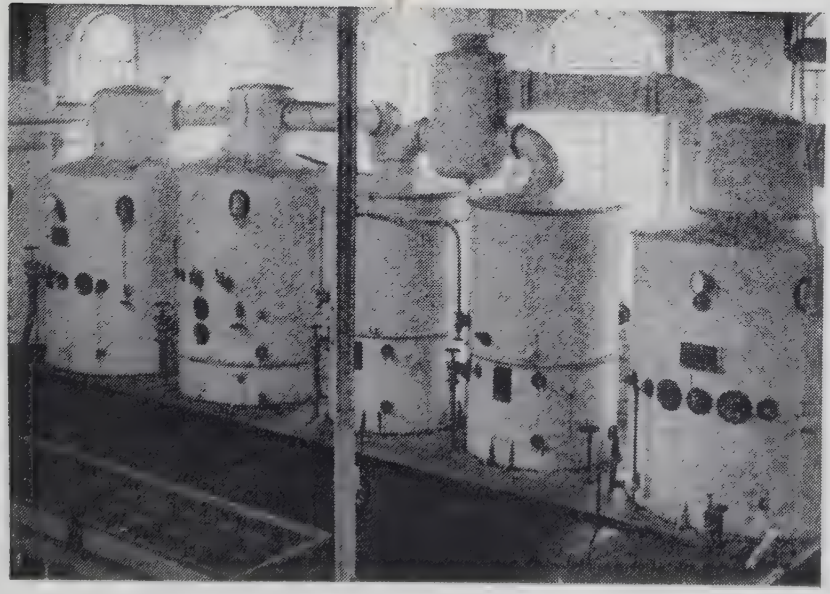


Saturation Pans (Hollandia Factory)
In these carbonic acid is passed through the lime-saturated juice



Thin Juice being Boiled at the Hollandia Factory at lower and lower temperatures, thus thickening the juice

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at the port of Maldon, in Essex. It was understood that the major part of the capital of the East Anglian Sugar Company, £160,000, would be provided by the Hummelincks, the big Dutch firm of sugar manufacturers, condensed milk makers, and creamery proprietors, who own the Hollandia Factory; but that English capital would be admitted if desired. The English directors were a distinguished Eastern Counties agriculturist, the Hon. Edward Strutt, who manages the estates of his brother, Lord Rayleigh; Mr. William Hasler, of Dunmow, whose name is also familiar to a wide circle of farmers in the county; and Mr. Trustram Eve, the well-known secretary of the Farmers' Club. The factory was to be ready by October, 1911, and a considerable amount of refining of imported sugar was to be done as a means of keeping open all the year round. A resident agent, Mr. Petitpierre, who had had sugar factory experience in Java and spoke English well, was sent over from Holland to Maldon to get the farmers to try beet growing. A local M.P., Sir J. Fortescue-Flannery, promised to remit the rent of the land of his tenants up to 5 acres devoted to beet, and the Essex experiment generally attracted a great deal of attention. An account of the farmers' experiences is given in Chapter IX.

Eventually, in February, 1911, Mr. Strutt and Mr. Hasler resigned from the directorate of the company. Primarily this was due to the large amount of English capital required for the venture at a time when the Essex and Suffolk farmers were discouraged over the financial losses they had sustained through causes which will be outlined in another chapter. The retiring directors stated that they retained their personal confidence in Messrs. Hummelinck and in the future of the beet sugar industry in favourable conditions. Mr. Eve retained his place on the board with the three Messrs. Hummelinck, who undoubtedly deserved thanks for the pioneer work they had done, at some expenditure of money, in furthering a practical knowledge of beet growing. As the Anglo-Dutch factory proposal was regarded by experts as in many ways the most promising attempt that had been made to establish a beet sugar industry, the turn things took was much regretted.

(2) NORWICH.—During 1910 a certain amount of beet was grown farther north, in Norfolk and Lincoln, for a Dutch firm, the factory of which is at Arnhem, and, under the auspices of the Norfolk Chamber of Agriculture, for Messrs. E. S. Ali Cohen and Van Agtmaal for export to Bergen-op-Zoom, and there was some talk, on their part, of a factory. Particulars of the crops are given in Chapter IX. On March 5, 1911, a meeting was held, under the auspices of the Norfolk Chamber of Agriculture, to hear Mr. Cohen outline proposals for a factory. He said:

> In 1912 there will be at least one sugar works in full working order within a radius of six miles of Norwich, provided you assist me with your support. If we could have succeeded in having in 1911 a factory put up near Norwich, I would have offered contracts for beet at 20s. per ton delivered free at the works, or 18s. 6d. delivered on the heap nearest the road and further transported by ourselves.
>
> Assuming that the crop of 1911 will have to be shipped to Holland. I will accept this crop at 20s. per ton delivered free on quay or harbour Great Yarmouth, Lowestoft, Lynn, or other convenient harbour. I will provide free seed, and will send over specialists to do the seeding with our own machinery, provided you give free transport of this to the next farm or railway station. I further will provide free supervision from the moment of preparing the land for the seeding till the crop is lifted. I will further assist you at our own cost with extra hands for the lifting and handling of the crop, which will not cost more than 25s. per acre.
>
> In the contracts for 1912 and following years I guarantee you 6d. per ton extra if our factory here pays 5½ per cent. dividend. besides

offering you 6d. per ton extra bonus for all beet containing 17 per cent. sugar and more grown over an area of at least 25 acres. I will further make such arrangements that no grower shall be hurried to forward his beet at the last moment, and will make such arrangements that a regular transport is secured.

If our instructions are followed up you will obtain at least 15 tons of clean beet per acre [" containing 16 per cent. of sugar," Mr. Cohen added later], as the average for Norfolk. I ask you further to believe that the leaves and crowns left on the field represent at least a fodder value of 20s. per acre (most of the authors and experts say of 35s.), and that you will improve your land, your other crops, and labour conditions.

A sugar factory cannot be erected before the manufacturer is assured for some years to come of the beet needed for his purposes. As repeatedly stated, small works do not work economically. My friends have works where are treated in one campaign, that is in from two to three months, an average of 80,000 tons of beet. Assuming we grow 15 tons per acre, this means an acreage of over 5000 acres. My friends in Holland are assured already for the next seven years of all the beet grown on an acreage of over 20,000 acres.

While I shall accept a smaller acreage than 10 acres, I should like, especially this year, when I have to concentrate my people so much as possible, that you should enter for larger areas.* Besides, I have to take into account that the distances from the harbours should not be too far away.

On April 1 Mr. Cohen confessed in a circular that " it looks as if farming conditions are of such a prosperous nature that the ordinary routine of farming life and the growing of mangolds, swedes, and other root crops seem to be more profitable for the majority of the farmers than the growing of sugar beet." For simplicity's sake he altered his rate for beets to 18s. 6d. per ton delivered free on rail or in lighter or wherry. In the contracts for 1912, he altered the period of contracting from five years to three years. Instead of 20s. he offered 21s. 6d. per ton free at works, or 20s. on rail, charging those who sell free on rail with the excess freight beyond 1s. 6d. per ton. He added:

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* SIZE OF BEET CROPS IN THE UNITED STATES.—The average here in America is about 10 acres for each grower to cultivate. Some cultivate as high as 50 acres, but we advocate 10-acre patches, as they are able to give the beets better attention, both as to cultivation and digging.—Mr. G. E. Collings, of Cleveland, U.S.A., in the *Hereford Journal.*

> I am willing to guarantee a profit of at least £3 per acre to those who will grow, in 1911, plots of 25 acres or more. This means that I guarantee a revenue of £12 per acre, assuming that the cost of production and delivery to rail or water are not more than the normal figure of £9 per acre. The revenue will be higher where at least 15 tons per acre are grown on ground approved of by my expert. Including £1 as the value of leaves and tops left on the field, the net profit should be £5 17s. 6d. per acre at a price of 18s. 6d. per ton. I give further free seed and seeding, and my assistance in obtaining the extra labour for the lifting and carting of the crop.

His guarantee that this labour should not cost more than 25s. per acre he withdrew, because it had been called "foreign and sweated." He had proposed, however, to pay Dutchmen he was bringing over 3s. 6d. per day. He continued:

> I am further willing to supply in 1911 every grower of a certain area with sugar-pulp (dried) guaranteed to contain 30 per cent. of sugar at the same price as it is sold to farmers in Holland, who are growers of beet, viz., £6 10s. per ton. I will sell this at the same price f.o.b. Harwich, so that any grower who fears he will not have fodder if he grows beet instead of his ordinary roots, will have fodder.*

Mr. Courthope's Factory.—Simultaneously with the inception of the Maldon scheme Mr. G. L. Courthope, M.P., was exerting himself in the direction of establishing a beet sugar company to have its factory at Ticehurst, in his constituency of East Sussex. He announced in 1910 that he was able to command the requisite capital, and

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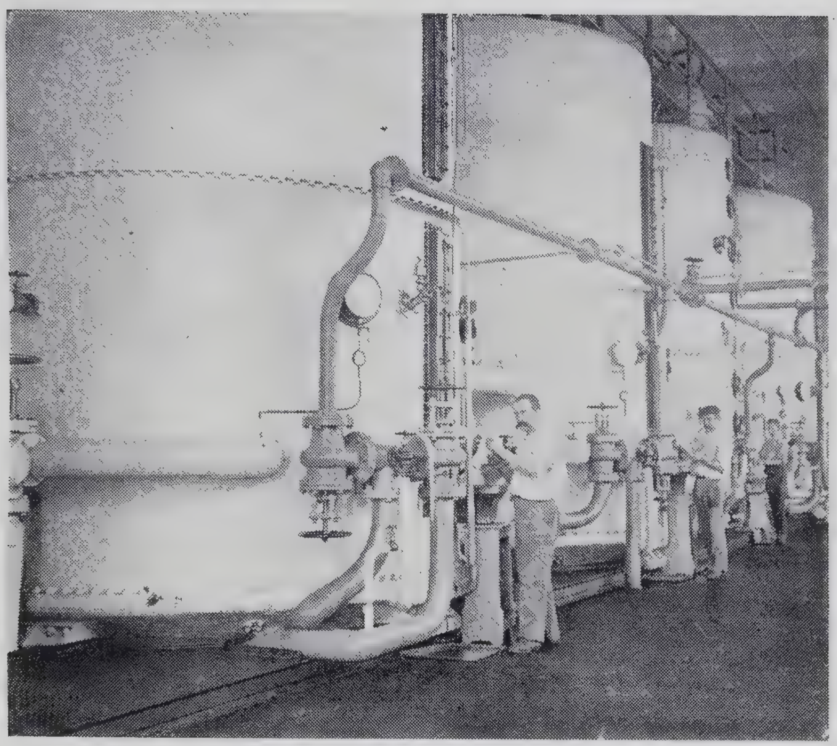
* For Mr. Cohen's sale contract, *see* Appendix.



HOLLANDIA SUGAR BOILERS DETERMINING THE STAGE OF GRANULATION OF THE THICK JUICE, BOILING AT A LOW TEMPERATURE IN THE VACUUM PANS

A little of the sugar crystals in the syrup is examined on a piece of glass held over an electric light. Note the little windows, through which the sugar can be seen boiling in the vacuum pans. The steam heat makes the sugar solution over-saturated, so that the sugar begins to crystallise out. Continuous application of heat and continuous addition of more juice evaporate more and more water, so that the sugar crystals grow. When the right stage of granulation is reached, the mass in the pan is let down into a cooling trough, where the crystals grow a little more. Centrifugaling follows.

DUTCH EXCISE OFFICIAL CHECKING THE SENDING AWAY OF SUGAR FROM A FACTORY

that a third of the required area of beets was volunteered. His work was interrupted, however, by the General Election of 1910 and by family bereavement. At the beginning of 1911 the situation was that several farmers had agreed to grow experimental beet crops with a view, it was hoped, to the signature in the autumn of such contracts for acreage as would justify the erection of a factory in the winter of 1911-12.

The Farmers' Contracts.—The terms of the contract which was offered to the Sussex farmers were as follows:

The grower agrees to grow not less than acres nor more than acres of beet per year for the five years commencing January 1, 191 , should he so long continue to farm within the district in which he now farms, and to deliver all the produce of such acreage to the company as and when the company shall require the same, in good condition, undamaged by frost, and shorn of leaves and tops.

The company agrees to accept delivery either at the factory or at railway station on rail, and to pay at the following rates per ton: For roots containing 15 per cent. of sugar, 18s. at factory; at station, s.; and for every unit of sugar more or less than 15 per cent., 1s. more or less per ton, *i.e.*, 14 per cent., 17s.; 16 per cent., 19s.; 17 per cent., £1, and so on.

The company further agrees to allow the grower free of charge such an amount of the saturation lime used by the company as is proportionate to the quantity of roots supplied by the grower.

The company further agrees to supply such of the slices, pulp, or residue of manufacture as are available far cattle food at a lower price than that charged for the same to other purchasers.

The company further agrees to pay to the grower as bonus, &c.

Below is a copy of the form of contract made by the Hollandia Company with Essex and Suffolk farmers:

1. The buyer agrees to supply free of charge seed of sugar beet to the farmer, together with drill or sowing machine,* also free of

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* The grower who favours me with a copy of this contract says no drill was supplied to him. Forks only were, I believe, imported.

charge, to the nearest railway station or quay on the terms and conditions as set out in the following clauses.

2. The farmer, in consideration of such seed being supplied as aforesaid, undertakes to sow this and no other seed in four acres of land in his occupation and to deliver between September 15 and October 31 free on rail to the buyer all sugar beets grown on it, at the price of 17s. per ton.

3. The farmer to deliver the sugar beets in sound condition and not bruised in the digging up. Sugar beets damaged through frost, water, or mould will be refused. The sugar beets to be cut off flat where the first leaves have grown and to be cleaned from earth.

4. Of every 4 tons delivered 56 lb. will be cleaned entirely and the tare fixed. The average of the different tares will be taken as average of the bulk. If the tare comes out above 20 per cent. the excess above 20 per cent. will be doubly deducted from the gross weights.

5. The beets shall be weighed at the riverside close to the barge, and the tares being deducted the farmer will receive receipts showing net weights delivered, and payment will be made on a given day within seven days from delivery, on production of the farmer's receipt at the price agreed upon in this contract.*

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* An American Contract.—Here is the vital part of a form of contract used in some American factories:

"The party of the first part does hereby agree with the said Company: That he will plant, cultivate, and harvest, during the year in a good and husbandmanlike manner acres of sugar beets, on the land owned or operated by said first party, said tract of land being a part of sec township of in the county of State of .

"That he will plant, cultivate, and harvest the said beets from seed furnished by the Company. That he will deliver to the factory of said Company the beets so raised by him under this contract, at such times and in such quantities as may be directed by the said Sugar Company, provided that no contractor shall be required to deliver to the factory more than two-thirds of his beets before the day of . That in harvesting said beets he will cut off the tops clean and square below the lowest leaf. That all seed for the planting of beets under this contract shall be paid for at

The Worcestershire Scheme.—In the Midlands the mayor of Kidderminster, Mr. Clement Dalley, principal of a firm of corn merchants, was interesting himself in the formation of a Worcestershire sugar beet factory, which in 1910 reached a stage at which the town council of Kidderminster agreed to grow on its municipal farm 25 acres of beets annually for five years. It was stated that the necessary acreage to supply 30,000 tons of beet was secured, and that

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the rate of cents per pound at and the amount due for same shall be deducted from the first payments made for beets delivered. That he will not dispose of any of this seed to other persons. That he will give prompt attention and bestow all necessary labour in due time and season.

"That all beets raised of a suitable quality under this contract shall be delivered to the Sugar Company, as above provided. That all beets not delivered by him to said Company prior to shall be properly pitted, which shall mean covered sufficiently to prevent freezing, withering, reduction of weight, and consequent loss of sugar.

"That in handling the beets he will exercise all due care, and not allow stones to become mixed with the beets in the wagon or car.

"The Sugar Company, party of the second part, agrees with the party of the first part: That it will always strive to furnish beet seed to said party of the first part, of a quality of the best that can be obtained by it for producing beets. That beets testing per cent. sugar shall be accepted by said party of the second part, and paid for at dollars per ton delivered in the Company's store sheds at its factory, and cents per ton will be added or deducted for every per cent. above or below per cent. That cents extra will be paid for every ton of pitted beets delivered under this contract after the first day of in answer to the call of the Company. That when beets are delivered in carload lots, the party of the second part shall unload them free of charge.

"It is further agreed that when and as the beets are delivered to the storage sheds of the said party of the second part, they shall be weighed, tared, and tested by the weighman and inspector, and when the amount has been determined as to the per cent. of sugar and financial negotiations were proceeding. At the beginning of 1911 it was stated in the Press that the company had been actually floated.* The financial arrangements were not then completed, however, and the German machinery manufacturers had intimated that owing to the late arrival of a definite order they could not guarantee the installing of the plant in time for handling the 1911 crop. A circular was accordingly sent to farmers who had agreed to grow beet, requesting them to carry forward their contracts until 1912. The Kidderminster factory was to be on a smaller scale than that proposed to be built at Maldon. The capital was £100,000, and £80,000 in £1 shares were to be issued. £60,000 were to be underwritten by "Beet Sugar Founders Limited" at 6 per cent. "Beet Sugar Founders Limited" is a company of which Mr. Sigmund Stein is adviser, and Mr. Dalley a director.†

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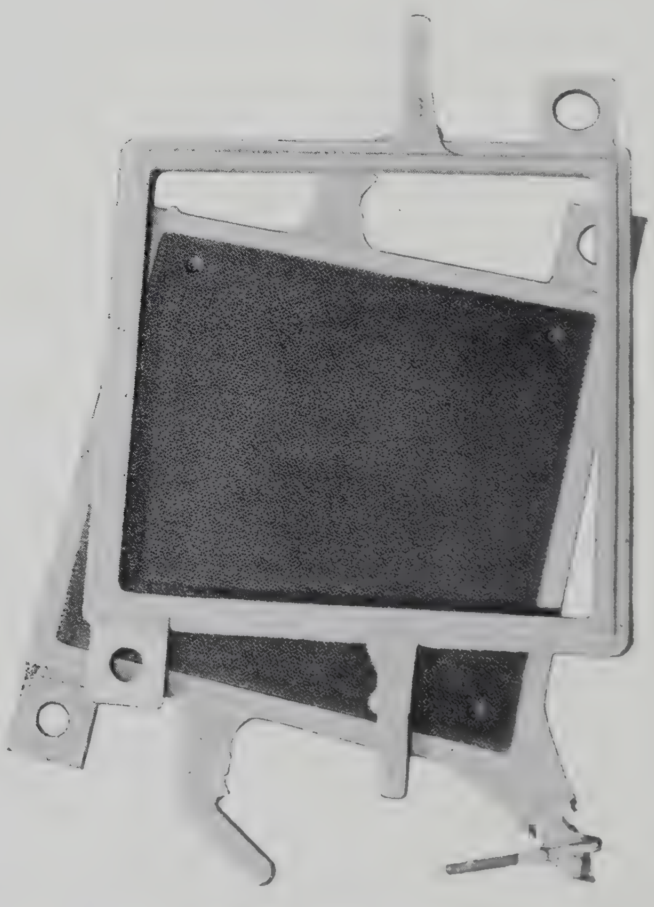
quantity of such beets, and certificate furnished therefor by said weighman and inspector, settlement thereon shall be had and payment made on the   day of each month for beets delivered during the previous month.

"The said Company shall not be required to take any beets that are rotten or otherwise defective so as to render them unfit for making sugar."

* The directors were to be Sir Sydney Lea, Bart., Major E. A. Knight, M.P., Mr. E. Russell Taylor, and Mr. Dalley.

† "BEET FOUNDERS LIMITED."—Extract from draft prospectus: "The company is promoted by Beet Sugar Founders Limited, a company incorporated in July, 1910, with a capital of £25,000, divided into shares of £1 each, with the objects (among others) of promoting the beet sugar industry, and of forming companies in different parts of the United Kingdom or elsewhere. The Founders Company shall have allotted to it 5000 fully paid shares of the company, and shall be repaid its out-of-pocket expenses, but shall receive no other cash consideration whatever."

Centrifugals at the Zvolenèves Factory
They hold about 8cwt., and are about 4ft. in diameter



Section from the Filter Press shown on another page
One pair of frames with canvas sheet

A manager for the Worcestershire company was to be engaged from the Continent, where, it appeared, three companies were earning dividends of 50 per cent.

It was stated that contracts for 1000 acres existed, and that a provisional agreement had been made for a 22-acre site with a canal and railway service. It was intended that the factory should have "a capacity for manufacturing over 5000 tons of sugar per season and producing the best white refined sugar direct, without the use of animal charcoal or chemicals, according to the latest and most improved processes." "Whilst not in operation for sugar manufacture," it was explained, there were "various industries for which the factory may be utilised, among them being the manufacturing of preserves, for which the factory, in the midst of a fruit-growing district, is admirably situated."

It was stated that beet manufacture in this country possessed several advantages, of which two were:

(1) Coal and coke cost less than one-half. The proposed factory will be so close to the coalfields of South Staffordshire that the necessary fuel can be obtained at about 7s. per ton delivered.

(2) Limestone is much cheaper, viz., about 5s. to 6s. per ton delivered.

Estimates "obtained from eminent beet sugar machinery makers indicated" that

The total cost for making and installing the entire machinery at the factory, including supervision for a period, will amount to	£44,500
The cost of the site will absorb	2,200
Buildings, excavating, roadway, &c.	18,000
	£64,700

Leaving what is, in the opinion of the company, a sufficient sum for working capital.

A letter from Mr. Stein quoted in the prospectus said :

> It would be extremely difficult to find a more suitable site for a sugar factory. I have considered the position from the point of view of the farmers. I estimate the cost of producing one acre of sugar beet roots, allowing for rent, taxes, seed, labour, manure, and cartage, to be £10. The production per acre should be at least 15 tons, which I estimate will yield to the farmer a clear profit of £5 per acre. I have carefully considered the position from the manufacturer's standpoint. Assuming that 30,000 tons of roots, the produce of 2000 acres, are purchased, this should produce :
>
> 3900 tons of white sugar, 300 tons yellow sugar, 500 tons of molasses, 18,000 tons of beet pulp.
>
> (1) On the basis of the past seven years' selling prices I estimate that the annual net profit would be £13,900.
>
> (2) On the basis of the average marked prices for 1910 I estimate that the net profit would be £19,000. The figures are arrived at after making provision for wages and trade expenses, depreciation on both machinery and buildings, and general establishment expenses, including directors' fees.

Other Proposals and Activities.—In Dorset, in 1910, Lord Alington offered 500 acres to help in the establishment of a beet factory, but the scheme did not get very far, and was abandoned. Proposals for beet growing and beet sugar companies were also heard of in many other counties, and numbers of meetings were held and frequently addressed by Lord Denbigh, who has taken a great interest in the subject for several years, or by Mr. Stein. The Maidstone Farmers' Club sent a special deputation to Germany, and other agriculturists also visited the Continent in search of trustworthy information.

The British Sugar Beet Council.—This organisation came into existence through the agency of Lord Denbigh and the Central Chamber of Agriculture, which had had a beet sugar committee for some years. Its executive committee (Lord Denbigh, Dr. Schack-Sommer, and Mr. F. F. Kemp) set itself to collect and collate data as to sugar percentages and crop weights for 1910, and at the end of January, 1911, published a report from which the following extracts may be taken:

> Full returns and samples for analysis were received from about seventy-five growers. In addition to these, fifty plots of a quarter of an acre each were grown in Herefordshire, where the local advisory committee tabulated and published their own results. The sugar contents of these latter were very encouraging, averaging 17 per cent., and the weights per acre, so far as they can be accurately judged from these small plots, were excellent, averaging about 19 tons per acre.
>
> It is also very valuable to note the fact that in many other varied districts of England roots have been grown with excellent results, not only in small experimental plots, but in some cases crops of several acres. As evidence of the above the following instances may be mentioned:

Berkshire, Wallingford ...	17·0	per cent. sugar ...	14½	tons per acre.
Cornwall, Marazion ...	17·3	,, ...	26½	,, ,,
Essex, Dunmow	18·7	,, ...	14¾	,, ,,
Gloucester, Staunton ...	17·1	,, ...	—	,, ,,
Kent, Canterbury	17·1	,, ...	15¼	,, ,,
Middlesex, Harlington ...	17·7	,, ...	16¾	,, ,,
Somerset, Bridgwater ...	18·3	,, ...	15¾	,, ,,
Somerset, Yeovil	17[illegible]	,, ...	15	,, ,,
Somerset, S. Petherton ...	17·3	,, ...	17½	,, ,,
Suffolk, Bury St. Edmunds	19·1	,, ...	13	,, ,,
Suffolk, Ipswich	20·5	,, ...	—	,, ,,

National Sugar Beet Association.—Early in April a company under this name was registered, with a capital of £25,000, in £1 shares, "to promote and extend the cultivation of sugar beet in the United Kingdom." The first directors (to number not less than three nor more than twelve), were the Earl of Denbigh, Mr. J. W. Dennis, of the well known Covent Garden firm; Mr. J. R. Drake, a leading sugar broker; Captain J. A. Morrison, M.P., and Mr. G. Pauling. Among those who have taken shares are the Duke of Bedford, Lord Lansdowne, and Lord Iveagh.[*] On the formation of this association Lord Denbigh retired from the National Sugar Beet Council.[*] His place was taken by Mr. G. L. Courthorpe, M.P.

In the spring of 1911 the Association engaged Mr. R. N. Dowling, formerly of Wye College, to investigate, in company with a German agriculturist, the general conditions of sugar beet growing on the Continent.

The Situation.—Even if all the projected factories were started they would be a small company compared with the list for which some enthusiasts see openings. To keep us independent of foreign sugar supplies would require, Mr. Stein has said, about 500 factories. "Forty million pounds might be safely invested," he said at the British Association meeting of 1910.

> If we produced only a million tons of our yearly sugar consumption [of 1,760,000 tons] (writes Mr. Saxon Mills),[‡] we should require more than half a million acres of land permanently under the crop. Three hundred factories, representing a capital of some £30,000,000, would be required to extract the sugar. These factories, built in the heart of the acres supplying their roots, would find work and wages for over 100,000 persons. Subsidiary industries without number would be created or stimulated by the new industry, and another 100,000 persons might thus be provided with work. A new class of agricultural labourer would be brought into being. These million tons of home-made sugar would mean a re-colonisation of our depopulated shires and villages with many hundreds of thousands of newcomers settled in healthy surroundings and economic comfort.

But what are the prospects of a few well-considered beet sugar factories? Can any of the sugar we import be produced at home? This is the question which it is the object of this book to examine.

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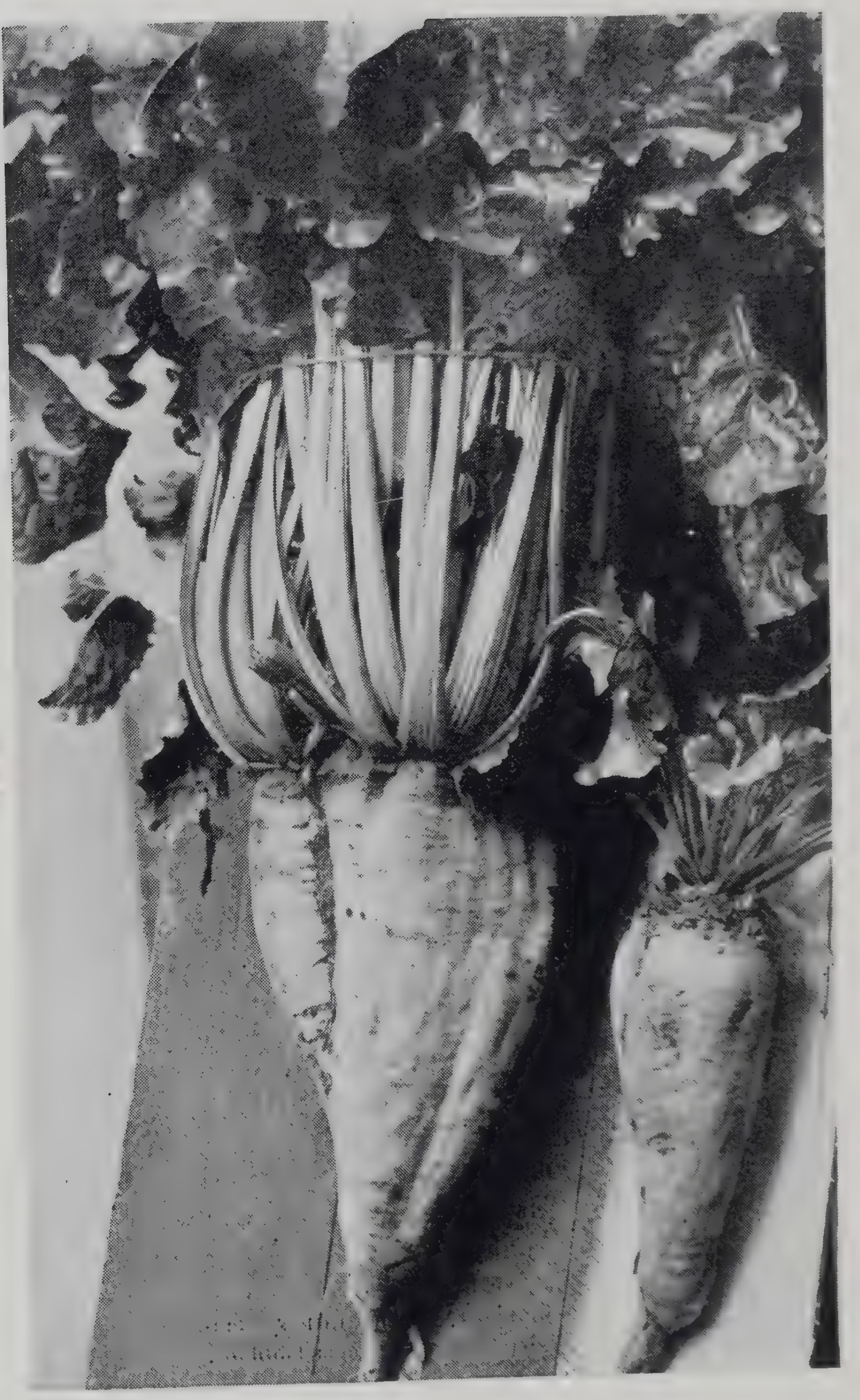
[*] *See* Appendix.

[†] *Nineteenth Century and After*, May 1911.



A SUGAR BEET AND A GARDEN BEET

One is white, the other red. Note the large head of the sugar beet

CHAPTER VII

SUN, RAIN, SOILS, AND SUGAR.

What is Sugar ?—Answering this question some years ago, Mr. Martineau replied quite simply that the beet and its leaves "are a very beautiful laboratory for the production of sugar. The root sucks up water and conveys it to the leaves. The leaves suck carbonic acid from the air and combine it with the water—and, behold your sugar!" As for the other sugar factory, made with hands, the one containing £50,000 or £60,000 worth of iron and steel, it takes away in the sugar it extracts from the beet "no constituent of the soil, but merely the sugar, which is water and carbonic acid." As a brief account of what happens this is no doubt sufficient, but our knowledge of the formation of the sugar in the beet is, actually, as the *American Sugar Industry* confesses, quite incomplete, many points being obscure. At the end of an interesting discussion of the problem, a contributor to that paper says :

> We know that, in general, beets high in sugar content have abundant foliage, that the sugar content is proportional to the size and development of leaf surface, that leaves lying flat produce more sugar than upright ones. The more continuously the sky is cloudy and the lower the temperature, the less is the increase of sugar. But even on autumn days, given sufficient temperature and intense light, the sound leaves of the beet will assimilate, the increase in dry substance being in no wise inferior to that of the earlier months.

All the leaves grown in August probably have but a small share in the production of sugar, as they do not have any wide surfaces. The reason why, as the season advances, a continually diminishing leaf surface suffices to assimilate the food taken up, is that the number of leaves increases in the same ratio as the surfaces of the individual leaves decrease.

It should also be considered how great is the surface of the foliage, that of a single full-grown leaf averaging 105-120 square centimètres. The total surface of the leaves of a beet was measured by Gohren in July at 6981, in September at 14,044 square centimètres, on which the sun can exert the influence that is necessary for the production of sugar or organic substance generally.

The work per day is very great. According to Pagnoul a bunch of beet leaves weighing 500 grams contained approximately 0·4 per cent., or 2 grams of sugar, about half of which descends into the root during the night. Hence in 100 days 100 grams of sugar, that is 14·16 per cent. of the final weight of about 700 grams, is carried into the root.

The work of the light in the leaves depends also upon the presence of certain mineral substances, and hence upon manuring. Potash, among the nutrient substances, is the one primarily concerned in the production of sugar. No less important is the presence of phosphoric acid.

Sunshine.—On the question of there being a sufficiency of sunshine in this country to permit of the successful cultivation of sugar beet, raised by Sir Walter Gilbey, there is no doubt, as a writer in the *Journal of the Board of Agriculture* (January, 1911) said, that

> the influence of climate is considerable, temperature, rainfall, and sunshine all having a direct effect on the successful cultivation of the crop, especially as regards percentage contents of sugar. By comparisons of meteorological observations since 1870 M. Pagnoul has concluded that the temperature in May, June, and July has a preponderating influence on the yield of the crop, and that of September a very marked effect on quality. The results of experiments since Lawes and Gilbert wrote show that a mean summer temperature of

70° F. is by no means necessary, for heavy crops containing a high average percentage of sugar have in many cases been grown in the Eastern Counties. In fact, as Petermann and Pagnoul appear to have found, the quantity of organic matter produced by the sugar beet probably depends more on light and rainfall than on the total heat received during growth.

The mean temperature of the Continental beet districts and of those localities in England where beets may be successfully cultivated, Newlands* points out, ranges from 62° to 65°F. (16½° to 18°C.):

> The formation of sugar is influenced not so much by heat as by dry weather and unclouded sky during the autumn. Hence the root succeeds far better in the north of France and of Germany than in Central France and Southern Germany.

The agent of the Hollandia Company at Maldon, who has lived in England all the year round, wrote to me in November, 1910:

> I must dismiss the lack of sunshine theory when I look at the reports which have been published of the analyses of the numerous samples of English beet which have been sent over at different times this year to Holland in order that comparisons might be made between the growth of sugar beet in England and on the Continent during the same period. Though we have had a very wet year, and therefore not at all suitable theoretically for beet cultivation, the sugar content of our English beets leaves nothing to be desired, and the average compares most favourably with that obtained on the Continent.

Rainfall.—"Nothing is so conducive to heavy crops," Newlands says,

> as an abundance of rain distributed over the first two months' growth of the plant. It would thus appear that the East and South-Eastern and Northern Counties of England, together with many localities in Scotland and a portion of Ireland, are, so far as the climate is concerned, well suited to beet.

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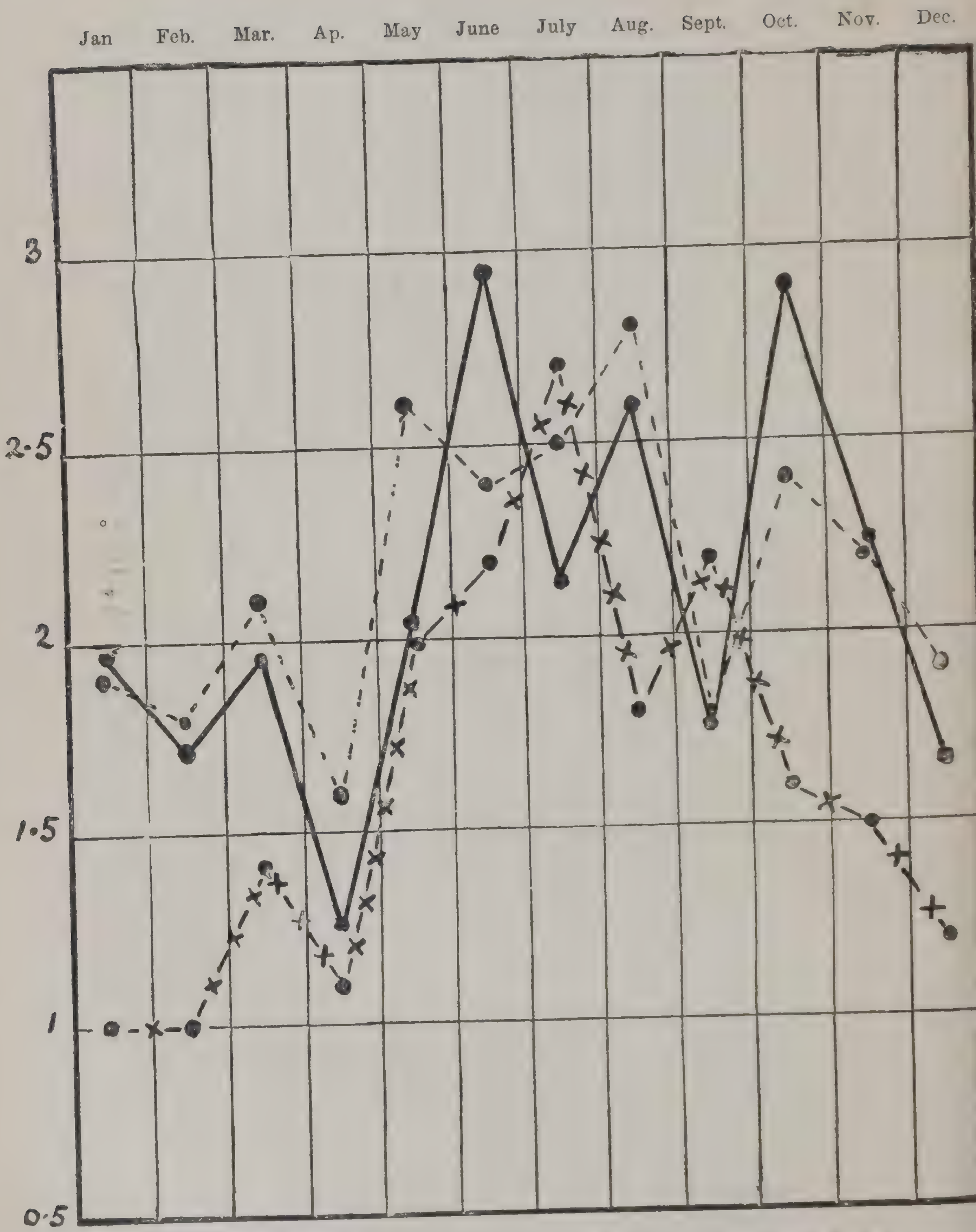
* "Sugar, a Handbook for Planters and Refiners," by the late J. A. R. Newlands and B. E. R. Newlands, F.I.C., F.C.S. (Spon, 25s.).



Comparative Rain Map: Eastern Counties ———; France - - -; Germany × × ×.

The *Journal of the Board of Agriculture* comes to the same conclusion:

> The sugar beet crop has need of considerable water, transpiration being heavy, and Hollrung states that for the growth of 1lb. of dry matter (= about 4lb. of the green plant) 40 gallons of water are necessary. As with other root crops, however, prolonged rains may be harmful owing to the difficulty experienced in keeping the crop clean.
>
> The diagram shows graphically the average rainfall of certain great sugar beet growing centres in France and Germany compared with the average of centres in the Eastern Counties of England. In arriving at the figures for the English district, the monthly averages were taken for Cambridge, Hillington, and Rothamsted for the five years 1902-6, and the graph represents the monthly averages for these three centres for the years named, that is, the average of fifteen sets of figures. In the case of France and Germany the monthly averages have been taken in the same way, the centres for the French district being Arras, Amiens, and Soissons (four years only), and for the German district, Halle, Magdeburg, and Erfurt (four years only).
>
> A comparison of the figures shows that in April all three districts have a rainfall between 1in. and 1·6in.; in May the rainfall for the English and German centres is almost identical (2in.), while that for France is 2·6in.; in June—a month when plentiful rain is needed for the crop—the English centre has a distinct advantage, which is, however, lost in July but recovered in August; and in the critical month of ripening—September—the three districts may be considered about equal.

"On the whole, therefore," the writer concludes, "the Eastern Counties appear to compare very favourably as regards rainfall with two typical sugar beet growing districts in France and Germany, and are not apparently at a disadvantage in this respect."

He adds what is obvious, that "warmth, sunlight, sufficient soil moisture, and a supply of soluble food material are requisite to enable the plant to manufacture chlorophyll, assimilate carbon dioxide from the atmosphere for the manufacture of starch, and to maintain the necessary transpiration."

"If the crop has a nice moist spring, plenty of sunshine in the summer, and a good long autumn," a well-known authority on the sugar beet said in an early letter to me, "it will be a good one. A dry spring, wet summer, and short cold autumn will give a short crop. But worst of all is a drought all through the spring and summer, such as in 1904." That year, it will be remembered, there was a shortage of over a million tons of sugar. A large increase in the sugar percentage of roots takes place during the last six weeks the crop is in the ground.

Soils.—The whole subject of soils is discussed very fully in the big sugar book of Newlands:

> The best soils are those in which neither clay nor sand nor lime greatly ponderates, but which contain these constituents, together with a fair proportion of organic matter, so mixed together that the land is neither too stiff nor too light, and crumbles down after being ploughed into a nice friable loam. All soils incapable of being cultivated to a depth of at least 16in. are unsuited for the growth of sugar beet. The subsoil should be thoroughly well drained, and be rendered friable by autumn cultivation and free admission of air.
>
> A deep, friable turnip loam, containing a fair proportion of clay and lime, on the whole appears to be the most eligible description of land for sugar beets. Lime is a very desirable element, for, in land deficient in lime, beets are liable to become fingered-and-toed.
>
> When well worked, clay soils, especially calcareous clays, are well adapted for beet cultivation, provided they are properly drained and of sufficient depth. On such soils a succession of beets may often be grown without manure, for many clays abound in all the elements of fertility. These, however, require to be rendered available for the use of plants. The most effectual means of thus providing plant-food are deep autumn ploughing, stirring of the subsoil, and similar mechanical operations, all of which tend to bring into action the fertilising materials which lie dormant in many clay soils in

practically inexhaustible store, and which, at the same time, improve the texture of the land, rendering it more friable and more readily penetrable by the roots.

Dealing further with "the mistaken notion that clay soils are not suited for the cultivation of beets, and that the crop will only flourish in light sandy soils," the same authority says:

> Some of the finest crops of beet are grown on clay soils, and some of the worst crops on light sandy land. Even stiff clays, when well drained, may be brought into a fine friable condition, when the land is broken up by the cultivator early in autumn, left in ridges as roughly as possible during the winter, and not touched until the spring, when it is well dragged and harrowed to kill the weeds and prepare for the sowing.*

As to light sandy soils,

> beetroots grow well if the land is in a good agricultural condition; sandy soils, however, are poor in plant food, and not well adapted for the cultivation of sugar beets. It is true such poor sandy soils may be enriched by the application of dung or other suitable manures; but as it is not desirable to grow sugar beets on newly manured land, poor sandy soils, which will not yield a moderate crop without manure, are not nearly so suitable for beets as soils which contain naturally a larger proportion of the mineral elements which enter into the composition of the ash of the beet.

The report of the United States Department of Agriculture on the beet sugar industry says that beets "succeed well on stubble land and better still following alfalfa (lucerne) or clover." The subject of clover land is further discussed in a later Chapter.

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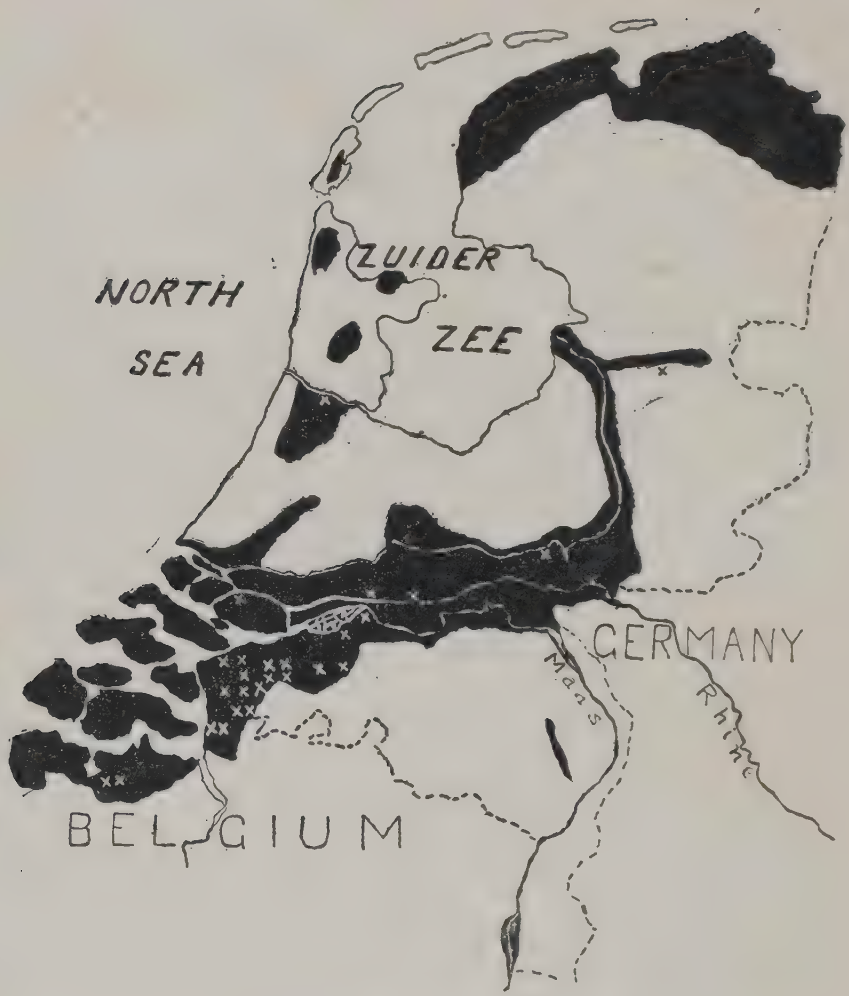
* "I have seen beet grown very satisfactorily on very heavy clay on the Imperial farm, Reichstadt, in Bohemia," Mr. A. Schobloch writes to me.

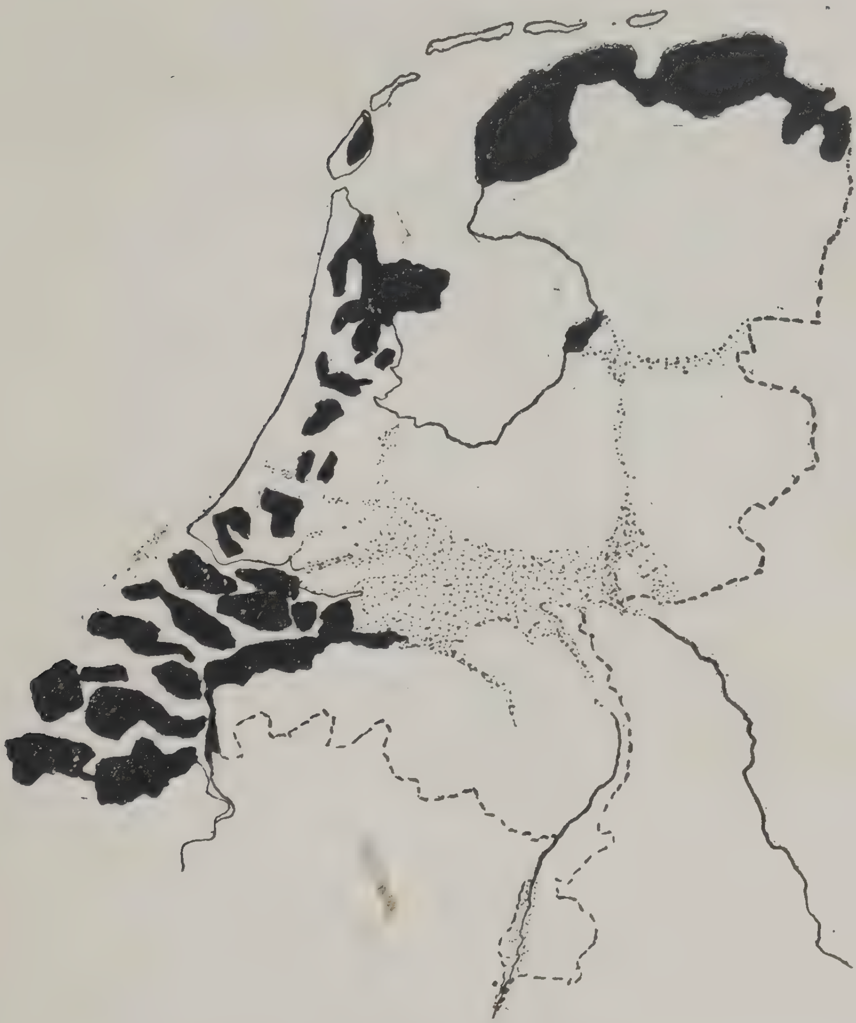


Sugar Beet Districts of Holland

Rough map, drawn by a beet sugar expert in Holland, in which districts which produce sugar beet are marked black, and factories are indicated by crosses. Holland is a quarter of the size of England without Wales.

Mr. A. D. Hall, writing in the *Journal of the Board of Agriculture* in 1905, said that though

beet can be grown wherever mangels are found, on the whole they are more suited to lighter and warmer soils that the mangel prefers, dry and warm autumnal conditions being particularly desirable to ripen the roots off. The east and south-east of England, with the south Midlands, are most likely to grow sugar beet of high quality.

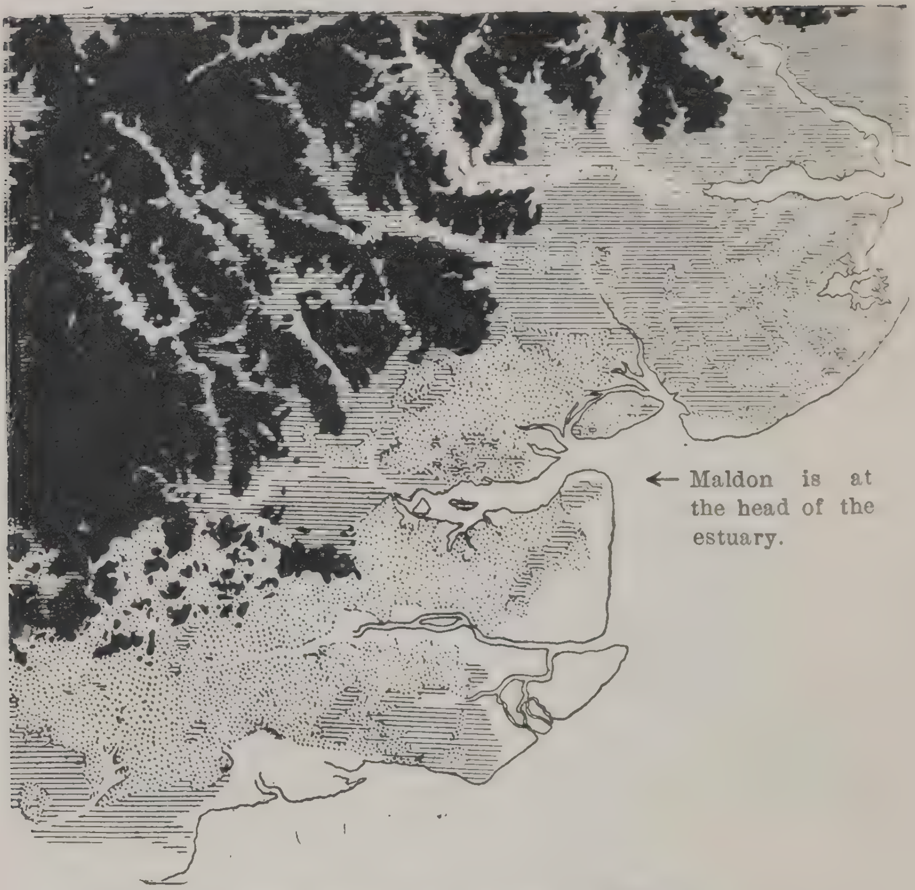


THE SUGAR BEET SOILS OF HOLLAND.

Geological map of Holland in which sea clay is marked black and river clay is dotted, showing, by comparison with the map of the beet growing districts, that the Dutch crops are mainly grown on these formations. All the black and dotted area would be under water if the sea and river dykes broke.

The *Journal of the Board of Agriculture*, in its issue for January, 1911, said:

It is suited for good, open, deep loams which are cool without being wet, also for sandy and calcareous loams if moderately supplied with humus. A good mellow soil adapted for growing barley and swedes,



Geological Map of Part of Essex.
Showing boulder clay, black; London clay, dotted; alluvium, white; gravel, sand, and other formations, in parallel lines.

easy to work, and readily penetrated by roots, if in a suitable climate, would grow sugar beet well. It is important that the soil be deep, porous, easily worked, and well drained.

The beet appears to be very responsive to lime, and good results are obtained on chalk soils, while on the Continent moorland soils are found to be quite suitable for sugar beet cultivation after being ameliorated by the use of sand and by draining.

Continental Beet Districts.—The beet is grown to perfection, the *Journal* notes, on the rich loams of Saxony, between Magdeburg and Halle, in Mid-Silesia, Brunswick, and Anhalt; it is also grown on the heavy soils in Westphalia, Thuringia, Saxony, the Northern and Southern slopes of the Harz, and on light soils in Mecklenburg, Pomerania, Southern Posen, and Altmark. In France sugar beets are chiefly grown in the following deparments: Aisne, Nord, Oise, Pas-de-Calais, Somme, Seine-et-Marne.

The accompanying maps exhibit the relation of beet-growing to soil formation in Holland. Although the sea and river clay may not be all equally heavy, ploughs have to be well-horsed, as a rule, to work it. A German writer suggests that in England "only mild, deep, rich soils will prove successful." Herr Zelter, a prominent East Prussian agriculturist, who was in England in 1910 and saw a good deal of the Eastern Counties, spoke to an interviewer as follows:

> The soil of England is for the most part more fertile than that of Germany; the rent is less than in Germany. On similar land the German farmer grows sugar beet with success, and pays double the rent the English farmer pays. There seems to be no reason why the cultivation of sugar beet, which is possible in Germany, should not be successfully carried out in England.

CHAPTER VIII

THE CROPS THAT WERE TALKED ABOUT

Experimental Plot Crops' Figures.—In 1903 the present Director of Rothamsted reported in regard to beet that "in dry and warm seasons it is possible to grow crops of average quality and more than average quantity." A few years later Mr. M. J. R Dunstan, of the Agricultural College at Wye, declared that "it is possible to grow a good crop of good sugar content."

Dr. G. Schack-Sommer's seven years' experiments, 1889-95, showed, in 1894, 14 tons per acre in England and 15 tons in Ireland, and a sugar percentage of over 14. For 1895 the tonnage was much higher, but Dr. Schack-Sommer writes to me: "For weights I was quite dependent on the farmers." In 1898 the average of British experiments was 15·7 tons. Averaging more recent experiments, six Suffolk experiments (Chamber of Agriculture), seven Lincolnshire experiments (Midland Agricultural College), some Essex experiments, the six years' experiments carried out in Warwickshire by Lord Denbigh, and also two series of experiments under the auspices of the Central Chamber of Agriculture, in which ninety-three persons took part, the crop returned was 17·76 tons per acre, with a sugar percentage of 15·59. Mr. Stein says that the average results of about 4000 experiments during the past twenty years "in practically every county of England, Scotland, and Ireland," with thirty-six different kinds of beet seed, was 17 tons 16 cwt., with 17·65 percentage of sugar.

During 1910 numbers of experimental crop results were published. As typical as any are those which appeared in the *Hereford Journal*, the editor of which, Mr. Saxon Mills, has done a great deal to keep the possibilities of beet growing to the front. The *Hereford Journal* thus summarised its report on the experimental plot crop grown in its county:

> In addition to the unusually heavy crops grown by Sir John Cotterell and Mr. E. Marfell of 27 tons 11cwt. 1qr. 20lb. per acre, that grown by Mr. George Edwards, of Great House, Dilwyn, works out at the phenomenal figure of 29 tons 8cwt. 2qr. 8lb. to the acre. The average weight, therefore, of 21 tons to the acre should be well maintained. The figures from Mr. Ling demonstrate the high percentage of sugar obtainable from locally grown roots. Such percentage is well over 17 per cent. in many cases, and even reaches 18·9 per cent.

How they were Grown and Harvested.—From inquiries I made in regard to the weights, made much of in some experimental crop returns, there is good reason for believing that in certain cases the roots were neither fully topped nor perfectly free of dirt when weighed. It is also more than doubtful whether in many cases a fair sample of the crop was weighed. It is by no means easy to take such a fair sample. In any case the returns on small experimental plots can have but a limited relation to the probable returns in commercial conditions.

The experimental plot results are largely, in Major Craigie's phrase, the work of "the best men under the best conditions." As to the lack of evidence as to whether crops were weighed clean or dirty, or whether the tops as well as the leaves of the beets were in every case removed, in the most recent of our agricultural encyclopædias Mr. Stein himself gives the vague instruction: "The leaves are to be cut off, but care must be exercised to leave the root intact."

Some Forecasts.—Until beet was grown in ordinary agricultural conditions for the Dutch factories in 1910 there were no data in this country as to the yields which might be expected in average field culture. Mr. A. D. Hall, F.R.S., had suggested in 1905 that the expectations of large tonnages were exaggerated, and at the British Association meeting in 1910 he expressed the belief that a yield of 15 tons was a reasonable figure to reckon upon. As he had written in 1905, "large yields are only to be obtained by spacing the plants more widely and by increased manuring, with the inevitable result of an inferior quality of root for sugar-making." Mr. B. E. R. Newlands, in his 1910 edition of his sugar text-book, spoke of English experimental work pointing to a yield of 16 tons per acre, with a percentage of sugar from 18 per cent.

Continental Crops.—Mr. Martineau, who in the seventies analysed beets in Thanet with a percentage of 15, did good service during 1910, when amazing statements were being made and accepted on the basis of "kitchen-garden plot" work, by drawing attention to the figures of Continental yields :

Average of Ten Years, 1899-1908.

Country.	Tons of roots per acre.	Percentage of sugar extracted.	Sugar per acre [Tons].	Tons of roots per ton of sugar.
Germany	11·868	15·49	1·83	6·4
Austria-Hungary	9·682	15·02	1·45	6·6
France	11·272	12·84	1·44	7·8
Russia	5·786	14	·81	7·1
Belgium	12·136	13·97	1·69	7·2
Holland	10·6	14·47	1·54	6·9
Sweden	10·9	14·37	1·56	7
Denmark	11·03	13·13	1·44	7·6

It will be seen that the crop average of Germany did not touch 12 tons, and that only one country in Europe (Belgium) did touch it. (The 140,000 tons of beets handled by one German factory—1908-9—are stated to have been grown at an average rate of only 10 tons per acre, against 10½ tons the previous year.) In Holland, whence the most pressing invitations have come to grow beet in this country—the reason is that the areas in the Netherlands available for beet are now filled up, as is also the case, it is understood, in France and Germany—the Government figures seem to show the average crop for 1905-8 to have been a little more than 12 tons, and for 1891-1908 a little more than 11 tons.

In the six States of America which have more than one beet sugar factory (that is, California, Colorado, Idaho, Michigan, Utah, and Wisconsin) the average annual production for the 1901-8 period is only 10·6 tons "of 2000lb. each" (our tons are 2240lb.), with a sugar percentage of 15·8.

And a Suggestion.—I ventured to suggest in 1910 that there was something to be said for the point of view that the average of our first crops was unlikely to exceed the average obtained in commercial growing by our nearest neighbours—France, Belgium, Holland, Germany, Denmark, and Sweden. Two countries, Russia and Austria-Hungary, which are excluded from this list have smaller yields than the six countries named. The average yield of these six countries during the ten years 1899-1908 was only 11·3 tons. No doubt the Continental yield is rising, and with our well-known skill in mangel-growing and our favourable climate we possess some advantages; but, bearing in mind the accumulated experience of the Continent on a beet acreage ten times greater than our mangel acreage, it seemed to be unwise, I suggested, to be unduly optimistic. In a little book in private circulation on behalf of the East Anglian Sugar Company no probable yield per acre in this country was given. "The chief reason is," it was explained, "that sugar beet has never been grown in England, except on small patches of ground for the purpose of experiment, and therefore no reliable data are available."

Quantity and Quality.—There is one way, nevertheless, in which those who grow mangels, and propose to grow beets, may get some notion for themselves of their prospective crops of beets. They may ask themselves how their crops of mangels compare with the average for the kingdom—20 tons per acre. If their crops are much higher, then there is some reason for believing that they might be able, by careful attention to the particular requirements of the new crop, to grow more beets than their neighbours.

But it must be borne in mind that the object of the beet-grower is not the same as that of the mangel-grower. The mangel-grower desires to grow fairly large bulbs;* the beet-grower tries to produce bulbs of a large sugar content. A German factory's annual report says that a large sum was distributed among growers "on account of the short weight but good quality of the roots."

In *Sugar Beet* the "advantage of small, well-shaped roots" is demonstrated by the following table in reference to roots of different sizes:

Weight. lb.	ozs.	Percentage Water.	Percentage Sugar.
1	0½	80·350	11·926
1	0½	77·974	14·551
1	1	79·568	13·502

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* Enormous mangels are now known to have inferior feeding qualities to medium-sized bulbs.

Weight. lb.	ozs.	Percentage Water.	Percentage Sugar.
1	2½	79·091	13·864
1	11½	81·995	11·226
1	14¾	80·623	13·185
3	4¾	86·210	8·872
4	4	85·981	8·845
5	9¾	86·614	8·491
6	11½	89·026	7·453
8	0¾	93·054	3·127
8	14½	92·021	3·655
8	7¾	92·487	3·523
9	8¾	93·714	2·699

It is of interest to note, however, that the common belief that small roots are necessarily richer in sugar than large ones is not borne out by analyses of large and small roots from five districts in Holland, made at the Hollandia Factory in 1910. "The difference in sugar in favour of the small roots is 0·04 per cent., which is absolutely immaterial; no doubt in further analyses the result may be just as well on the side of the large ones."*

Continental experts have repeatedly insisted that beet growing must not be thought of as a thing to be conducted on the same lines as mangel growing. If it could be so conducted the matter would need no great consideration. The farmer would simply be in luck's way. He would have the extraordinary chance of substituting for a crop, the return for the major part of which he cannot touch until he has turned it into stock—and sometimes cannot touch then—a crop for which the price is fixed a season or even five seasons ahead, and is payable within a week of delivery.

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* The subject is further discussed in Chapter XI

CHAPTER IX

THE CROPS THAT WERE RAISED IN EAST ANGLIA

The Acreage.—During 1910 some 200 acres in Essex and Suffolk were put down to beet for the Hollandia Company and 53 acres in Norfolk for the Arnhem Company. A smaller crop—30 acres—was also grown in Norfolk for a Dutch syndicate, represented by Mr. Ali Cohen. Some details are available as to these crops. A certain amount of beet was also grown in Lincolnshire.*

Sugar Percentages During Growth.—Between August 14 and 20, when the beets were not, of course, ripe, three or four roots each were drawn by an expert from the fields of nine Essex growers for the Hollandia Company. The average sugar analysis was 14·18. On September 29, when the beets were at a more forward stage but still not ripe, an Essex grower despatched to Gorinchem a sample of beets the analysis of which came out as follows:

How Grown.	Sugar percentage.	Average.
12in. apart, mixed soil (2)	15·70	14·18
12in. apart, mixed soil (1)	14	
24in. apart, light land (2)	13·90	
Grown in clay (2)	14·40	
Grown in black soil (2)	12·90	

Weekly during the beet season, it may be explained, the well-known sugar firm of F. O. Licht publishes average beet weights and average sugar percentages (1) for the Magdeburg beet growing district of Germany, and (2) for the rest of Germany.† The comparative German figures for the week in which this analysis was made were Magdeburg, 15·90; rest of Germany, 15·63.

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* The figures of the Board of Agriculture's crop returns are: Essex, 143 acres; Suffolk, 102; Norfolk, 116; Lincoln, 52; balance elsewhere (24 counties).

† *See* Appendix.

Now we come to the period when the beets were maturing. On an unreported date five more lots of Essex roots were analysed at Gorinchem, the average being 17·04 per cent. of sugar. The average of 160 samples of beets grown in Holland, received simultaneously at the Hollandia factory, showed 17·3 per cent. of sugar. A further analysis at the Dutch factory of twelve Suffolk growers' beets showed the following result in comparison with Dutch and German averages:

October 1-7 ……	Suffolk ……………………………	18·3
,, 7 ……	Magdeburg ………………………	16·55
Same week ……	Germany …… ………………	15·34
October 8-14 …	Dutch beets at Hollandia factory	17·1

Summarised, these last two tables are:

October 7-14, 1910.			October 1, 1909.*
All Germany.	Holland.	Essex and Suffolk.	All Germany.
15·94	17·2	17·32	17·42

On a later page will be found tables supplied to me by the Hollandia Company, giving the results of the analyses of representative Essex and Suffolk beets in July and August, and also instructive notes on the cultivation of the crops, a subject which will be dealt with later.

So much for analyses of growing roots.

Sugar Percentages of the Crop.—During the time the beets were being received by the Hollandia company I was favoured with notes of the analyses of cargo samples. From this data I compile the following table of the sugar percentages shown in comparison with the Dutch beets handled simultaneously in the factory and with the figures emanating from the German factories in regard to German beets:

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* The season being earlier, there were no comparable figures for October 7-14.

Port from which barge sailed.	Sugar percentage of English beets.	Sugar percentage of Dutch beets dealt with same time.	Sugar percentage of German beets dealt with same time.
Maldon (1)	16·9*	17	16·61
Lowestoft	18	16.8	
Maldon (2)	18	16·8	
Ipswich	17·6*	17·1	
Snape	18·2	17·3	16·5
Ipswich	18·7	17·4	
Maldon (3)	17·6	17·4	
Maldon (4)	17·8	18·4	16·57
Snape	17·6	17·7	
Maldon (5)	18·3 Dec. 10		
Sutton Bridge	16·6* Dec. 12	17·7 (Dec. 7)	16·48 (Nov. 27—Dec. 3)
Bradwell-on-Sea	18·8		
Averages	17·8	17·3	16·54

With regard to the roots shipped by Mr W. E. Sawyer, Roughton, Norwich (who acted as agent for the Arnhem company, and has shown a great deal of interest in the beet sugar question) I am informed that the analyses of five lots "representative sorts and conditions for various plots, comprising an average sample of the respective soils experimented on," were "universally good and even, viz., 16·9, 16·3, 16·3, 16·7, and 16·4 per cent.," or an average, let us say, of 16·5 per cent.† Striking an average between this sugar percentage and the sugar percentage of the larger quantities of beet analysed by the Hollandia people, 17·8, we have as the average for all East Anglian shipments to the Arnhem and Hollandia factories, 17·1, in comparison with 17·3 for Dutch beets, and 16·54 for German factory beets.

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* Had begun to sprout. One barge was four weeks in crossing from the Blackwater to the Maas.

† The details of the analyses of the roots which yielded 16·9 per cent. of sugar showed: Sugar in roots, 16·9 per cent.; specific gravity, 20·1 per cent.: beet sugar in juice, 18 2 per cent.; non-sugar (apparent) in juice, 1·9 per cent.; co-efficient of purity (apparent) in juice, 90·5 per cent. The higher sugar percentages of the Hollandia beets may, perhaps, have been due to the fact that they were harvested and shipped later than the Arnhem Company's.

The sugar percentage given some months afterwards by Mr Cohen for his 30 acres was 15·7. As, however, the quantity sampled by the Hollandia Company was the produce of very much more than 30 acres—there was some 1816 tons of it—it is not fair to strike an average between the total of the Hollandia and Arnhem beets and Mr. Cohen's, but if we do so the average is still 16·4, to all intents and purposes the same as the German total, 16·5. (The average sugar percentage for the whole of Germany for the sugar campaign of 1910 was 16·7.)

Nobody of experience in the beet sugar industry would dream of attaching too much importance to such averages. They must be very rough estimates, and they have no reference to weights. But taking the figures for no more than they are worth, they seem to show that whatever the results from experimental crops in this country may have been, *beet has been grown in East Anglia, and may presumably be grown in many other parts of England, in ordinary agricultural conditions, with an average sugar percentage equal to that of Holland and Germany.*

Norfolk, Suffolk, and Essex Weights per Acre.—Now for the weight per acre. The first trustworthy Essex report I received was in regard to a crop belonging to Messrs. Hasler and Clapham, within a few miles of my house. On 3½ acres of black land, which was in excellent order, there was a yield of 11¾ tons per acre. The roots were grown a foot apart. Another crop was grown by the same firm on 1 rood 39 poles of heavy land which had been spade dug by an out-o'-work, but had received no special cultivation. The yield was at the rate of 14 tons 13cwt. per acre, or only 7cwt. below Mr. A. D. Hall's forecast for this country.

Before further Essex reports of washed weights were forthcoming, Mr. Sawyer's statement of the average yield in Norfolk was published as 9½tons. The following are the details:

Acres.	Soil.	Tons	cwt.	qrs.	Remarks.
2	Good mixed soil ...	25	1	2	Well done, suitable land.
4	Light..................	48	0	0	Well done, highly farmed.
2	Good mixed	25	9	2	Well done, well farmed.
2	Light and sandy ...	18	16	3	Well done, not suitable.
2	Light..................	18	8	0	Well done, not suitable, too light.
1	Good mixed soil ...	11	2	0	Well done, carefully supervised.
2	Light medium	21	13	0	Well done, highly manured
2	Wet, marshy land...	8	6	0	Totally unsuitable, not attended to.
1	Light and sandy ...	8	14	1	Not well looked after.
2	Good mixed soil ...	25	14	0	Highly manured, well done.
1	Good mixed, rather wet.	10	19	2	Well farmed.
8	Gravelly and sandy	51	4	2	Not suitable.
2	Light sheep land ...	19	15	3	Well done, not specially manured.
6	Medium mixed soil	64	2	3	Well done and attended to.
1	Allotment, poor land	9	19	3	All hand work and attention good.
2	Allotment, poor land	16	14	1	All hand work, not so good.
1½	Rather heavy good land	15	1	0	Good root land, well done.
1	Good mixed soil ...	11	14	0	Good root land, well done.
2	Cold, wet land	9	2	2	Drilled on the flat, not suitable.
3	Good mixed soil ...	31	10	0	Well farmed and manured.
2½	Light, but lays warm	31	0	0	Very surprising result.
3	Similar	29	6	3	Badly worked.
53		511	15	3	

THE CELERY-LIKE HEAD OF THE SUGAR BEET

It will be noticed, as Mr. Sawyer says, that where the crops received fair treatment and the land was at all suitable, the yield was from 10 tons to 12 tons. Mr. Sawyer writes to me: "It should be noted that the crops were, with one exception, grown on ridges, about 24in. apart, so the land did not carry half the plants it should when drilled according to Dutch advice, 12in., and cut out 12in. The growers were bound to send in clean roots, and as the weather was favourable, little mould was shipped."

Crop Forecasts.—Mr. Sawyer says: "In a favourable season, after the experience gained, I think we should grow 14 to 16 tons."

No further details of the weights of the Essex and Suffolk crops have been published by the Hollandia Company than are to be found on a later page. Their agent has simply stated that the yield at washed weights was some 7·9 tons an acre. But it will be seen from the table referred to that several crops rose to 10 tons per acre, and two to more than that. Writing to the press in March, 1911, the Hollandia's representative mentioned that "five farmers who grew beet over an area of 35 acres" had crops which "ranged between 5 tons and 14 tons of cleaned roots per acre, making an average of 10 tons per acre." I have a note of his having said to me that the minimum crop on good land should be, with proper cultivation and attention, between 14 and 16 tons, and 18 tons should not be unusual. An experienced Essex farmer with three farms said to me: "On good friable soil we can grow 20 tons when we have experience."

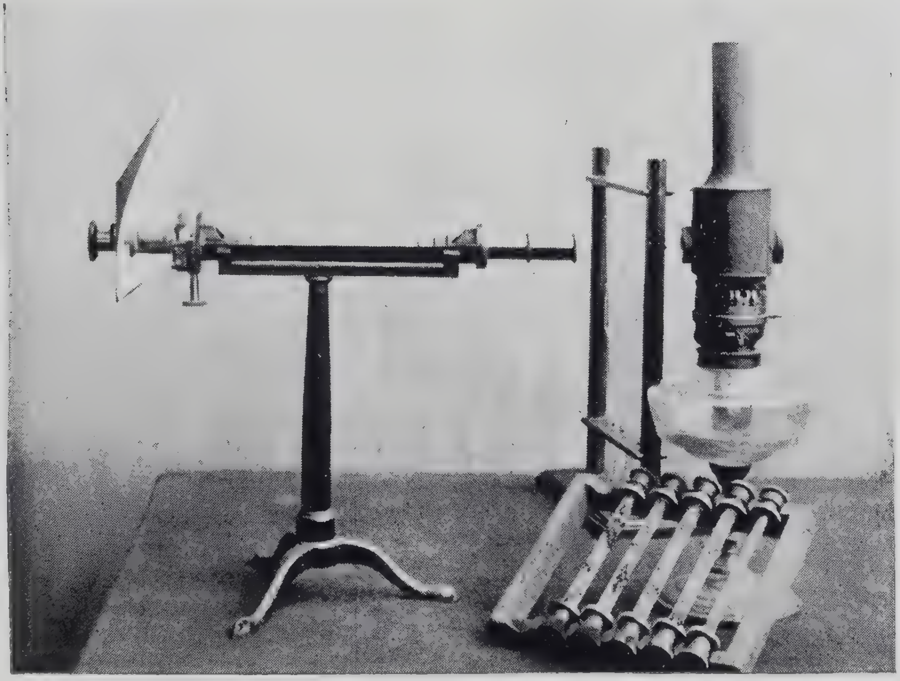
Particulars of a few crops in Essex have been given by different growers, but as the degree of cleanness attained by the roots is not always stated, their value is not great.

The Hon. E. Strutt informs me that from 12 acres he delivered "roughly 15 tons per acre at the station." Mr.

J. M. Welch, of Dunmow, tells me that his crop on 3½ acres "after deduction for dirt was barely 7 tons."

The Carriage of Dirt.—The beet weights returned by the factory are, of course, washed weights. As soon as the first barges of beets from Essex began to arrive in Holland I began to hear of remarkable percentages of dirt. Note, however, that this was merely the dirt adhering to the beets when they arrived at the factory. In addition to this dirt, "several tons of earth were left in the barges." The dirt left in the English railway waggons and carts has also to be taken account of. This dirt in the railway waggons was a very considerable quantity. One Essex grower's foreman said that he believed that he had loaded a ton of dirt into every one of his trucks. Another grower found by weighing that his beets were carrying away 3lb. or 4lb. of dirt a hundredweight, and he was advised that when one of his trucks was emptied there was 4cwt. of dirt left in it. Mr. Petitpierre, the agent of the Hollandia company, wrote to me: "I have seen trucks arriving at Maldon where it was impossible to distinguish the beets, my impression being at first that I had consigned to me a truck of earth." "Up to 40, 50, and even 60 per cent." in all had to be deducted from consignments in order to arrive at the weights for which the farmers could be paid. It is not only that the beets had had a lot of dirt carted with them. Many of the beets had lost their tails, which of course contain sugar, and had not had their valueless tops properly cut off. It had been repeatedly explained that the part of the beet above the ground line was to be cut off by the farmer. If he omits to do this the factory makes a corresponding reduction in paying him.

I went down to Maldon to make inquiries and was assured that in some cases the dirt had gone up to 70 per cent., and had averaged, at the very least, a third of the



THE POLARISCOPE
For description, *see* page 381

THE DIRT BROUGHT BACK BY ONE OF THE BARGES WHICH TOOK SUGAR BEETS TO HOLLAND FROM MALDON

consignments. On looking through the records of the beets received from different farmers I came in succession on the following percentages of dirt:

76½ 21½ 34 51½ 59½ 74½ 39 36 55 61 24½ 61½

The last seven, I noted, were from Hatfield Peverel, Dunmow, Witham, Dunmow, Dunmow, Witham, and Witham respectively (see annexed table.) I interviewed a man who had barrowed a lot of the beet from the railway waggons to the barges. He said that while many Suffolk roots—they were pulled in dry weather—were beautifully clean, some Essex ones were in a shocking state: "When the barge was full you simply saw dirt with beets sticking up here and there through it."*

A Serious Matter.—This dirty beet is a serious matter, not only for the farmers who pay for cartage and carriage as well as labour for which they have no return, but for the factory, which has an unusual amount of beet washing to do. The problem has to be faced in Germany as well as in the Eastern Counties, as the following extract from a letter of a German correspondent shows: "When the autumn is very wet and the soil is heavy clay you will find Germany has also 50 per cent. of dirt on the beets. We have here near Magdeburg an average soil, and this year the dirt percentage at the factory has been 20 per cent."

Although the matter was mentioned in their contracts, the East Anglian farmers had evidently not realised that the weight per acre is the weight after washing. When they received their cheques they were therefore appalled by the difference between what they supposed to be the weight of their crops and the washed weights returned by the company. The explanation of the heavy dirt percentages, which so greatly puzzled and irritated Essex farmers (until they read the passage in their contracts, to which the company referred them on complaint being made) is that the custom, in reckoning the deduction to be made, is to double the amount of dirt when it exceeds 20 per cent. Thus 40 per cent. of dirt would be counted as 60 per cent. After the event it is easy to see that it would have been well had Messrs. Hummelinck warned inexperienced growers, as pulling time approached, that there must be heavy deductions for dirt.

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* A Suffolk farmer writes: "I grew three acres last year, which we found hard work lifting when the land was dry, but a shower came during the operation, and we pulled quite half of them with our hands."

The Facts as to the Treatment of Crops.—But everyone who examines the accompanying table of field reports on the Essex and Suffolk beet must admit that other factors than dirt contributed to make the East Anglian crops financially unsuccessful. In Holland and in other beet growing countries the factories send skilled representatives to visit over and over again the crops which are being grown for them. These experts give advice to the growers, make careful reports of the condition of the crops, and periodically draw sample roots for analysis. When the analyses made at the factory are unsatisfactory the company at once corresponds with the growers and gets them to correct the treatment they are giving their crops. During the growth of the East Anglian crop a representative of the Hollandia company made, on at least two occasions, reports on a large proportion of the crops grown. The accompanying table, compiled from his reports, makes it very plain why the crops were no larger than they were. It accounts for only 152 acres out of the 250 grown, but it is, I believe, representative:

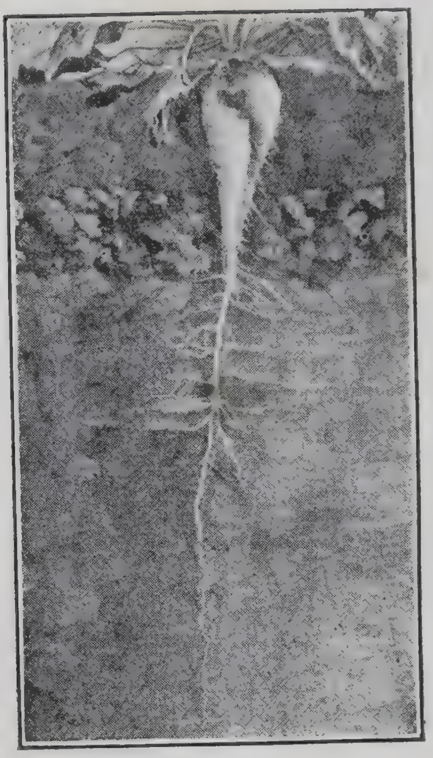
Causes of the Bad Crops.—The outstanding difference between the beets grown in East Anglia for the Hollandia Company and the beets it gets in Holland was the higgledy-piggledy sizes. Dutch crops are commonly composed of either large, medium, or small beets. The English roots were of all sizes. There might be seen in the same field beets the size of radishes and others 5lb. in weight. This was largely due to improper singling and insufficient thinning. What was wrong with our beets was:

(1) They were drilled nearly a month late, which meant that they had to be raised before they were ready.

(2) Little land had been ploughed deep enough for the crop.

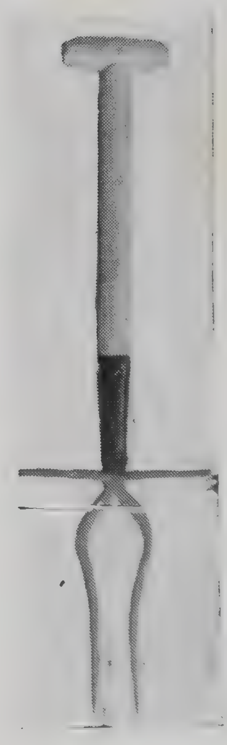
(3) As the table demonstrates, hoeing and singling in a large number of cases were done very badly, yet the crop is one which normally makes a particularly fine growth in its first weeks. (Suppose kitchen peas had been tried for the first time in East Anglia under the same uncongenial conditions, would not a certain number of the farmers have reported that peas were an uncertain and unsuitable crop?) When the ill-used beets emerged from the poorly prepared ground, their growth was arrested or their constitutions were otherwise enfeebled by the smother in which they found themselves. If a child is improperly fed and is given insufficient fresh air during part of its life, yet is afterwards more suitably fed and provided with better conditions of life, it will no doubt pick up, but it can never be the child it would have been if it had received proper attention. The healthy and well-used beet puts forth a marvellous growth of leaves with which to manufacture sugar; the less healthy and less well-used beet puts forth a smaller growth, and is therefore a less successful sugar producer.

(4) Beets which were given some care were often too close.



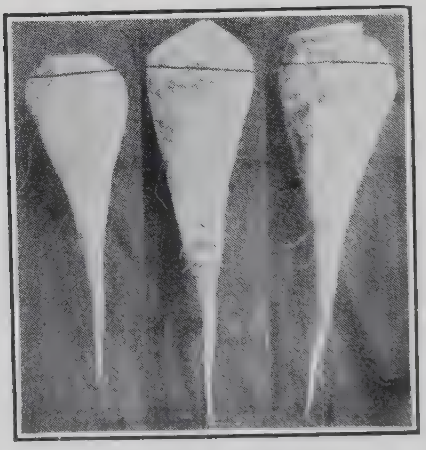
Root System of the Beet at 133 Days

From a U.S. Department of Agriculture's "Farmers' Bulletin." Depth of root, more than 3ft.; greatest fibrous rooting, from 8 to 14in.



The Fork Used in Holland for Digging Beets

Stronger forks of the same pattern had to be made for use in Essex



Beets should be topped according to the amount of root which has been above ground. *See* page 137 out of the rows was done three weeks too late, and the singling was delayed until the beets were sometimes 10in. high. This year's experiments are no criterion of what may be expected. The sowing in England was done about three weeks later than on the Continent, and therefore the plants had not a fair chance this year.

Suffolk.—Some account of Suffolk crops is furnished by a correspondent in that county:

So far as I have seen, where beet has been grown in Suffolk for the Dutchman, it has been most carelessly and ignorantly done, with very poor results. The land has not been ploughed more than 4in. or 5in. deep, and the manure has not been either suitable or sufficient, so I have no doubt the cultivation will be widely condemned. I looked at 5 acres the other day which contained more weeds than roots. The roots were about the size and shape of an apple with long fangs.

Norfolk.—The following note from Mr. Sawyer refers to the crops grown by farmers in Norfolk under his contracts:

The drilling was done too late owing to initial difficulties of getting farmers to give the industry a trial, and did not take place until about May 12 to 14 instead of April 12 to 15. Cutting out, in the case of farmers used to swedes and mangels, was difficult to get done, and so many found, when lifting time came, that their weight did not come up to expectations.

Another correspondent in Norfolk writes to me:

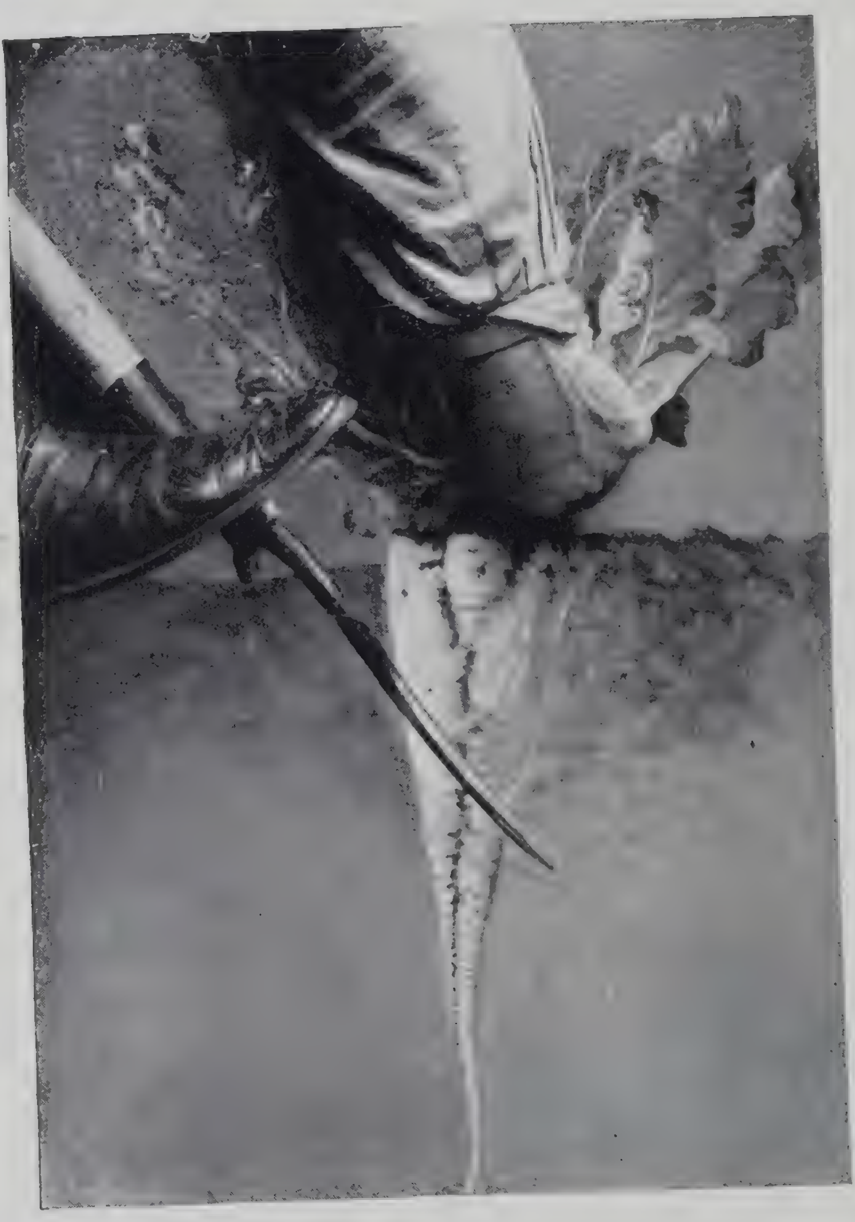
The seed was put in anyhow, and a long way behind time. Then they sowed on shallow soils, not subsoiling, with the result that most of the roots were stunted and fanged. Some of them sowed them on baulks, so that when they were hoed a good part of the root was above ground, which meant a heavy percentage in loss of sugar. I think it should be impressed on would-be growers that they should be sown on the level with a depth of not less than 10in. to 12in. of soil.

I may add the following statement made by Mr. E. S. Ali Cohen (*Standard*, March 1, 1911), in regard to the crops grown for him under the auspices of the Norfolk Chamber of Agriculture:

> It is customary on the Continent to prepare the ground for beet growing by deep ploughing and manuring in the autumn, but this obviously could not be done last year in Norfolk, though in some cases the farmers had prepared their ground in a similar way for their customary crops.
>
> Time did not admit of an analysis of the various plots secured, and it was therefore left to the practical knowledge of the expert to select the seed, of which there were three kinds, each specially adapted for a certain quality of soil.
>
> The sites, some fifty-seven in number, were scattered all over Norfolk with the object of obtaining, from the expert point of view, a true estimate of an average crop.
>
> The seeding on the Continent is conducted generally by specialists, but owing to unforeseen circumstances these men were unable to attend in time, so that the planting had to be done by the farmers themselves under the instructions of my expert. Generally speaking, these instructions were carried out, but, perhaps not unnaturally, in some instances the principles were not thoroughly understood; and, again, certain farmers were of opinion that their own methods of seeding were preferable.
>
> The seeding was done during the last weeks of May and the first weeks of June, some six or eight weeks too late. The climatic conditions were anything but favourable to the experiments, the official records showing the rainfall of 1910 to be in excess of any year since 1879. In many cases the fields where the beets were planted were flooded, but notwithstanding this, and although sufficient attention had not been given to the weeding and hoeing or the singling of young plants, the expert who came over to Norfolk in the month of August to inspect the crops was well satisfied with the results of the test.

Crop Anticipations.—Mr. Cohen goes on:

> From thirty acres of land there were obtained 420 tons of roots, from which had to be deducted 50 tons "tare" for rough cutting of the crown and soil attached, leaving a net product of 370 tons or, say, 12½ tons net per acre.



How the Dutch Worker uses the Digging Fork
But he does not, of course, wear a kid boot!

The average quantity of sugar obtained from the roots was 15·7 per cent.

Having regard to the unfavourable conditions under which the crop was grown, the result may be considered as eminently satisfactory, and it affords ample proof that if beet were planted and grown on an industrial scale there might be anticipated in normal seasons, on a very conservative estimate, a return crop of 15 tons per acre with an average of 16 per cent. of sugar.

Official Figures of Beet Exports.—It was stated in the House of Commons on February 20, 1911, by the President of the Board of Trade, that "the registered exports of sugar beet to the Netherlands from East Anglian ports in 1910 amounted to 3909 tons, of a declared value of £4,133." In view of the high proportion of dirt with these consignments, the tonnage is untrustworthy as an estimate of crops. The declared value of the cargoes works out, it may be noted, at 21s. 1d. per ton.

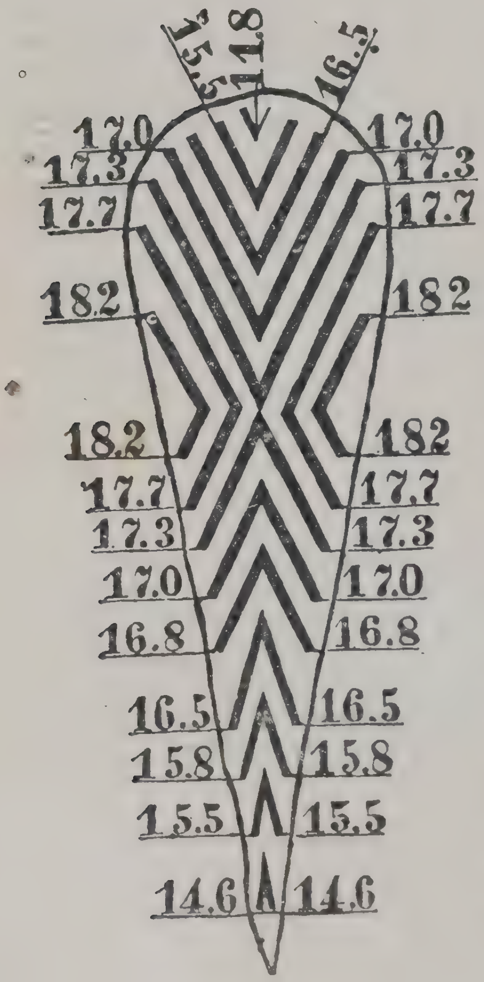
Summary.—In 1910, in altogether adverse conditions in regard to experience and cultivation, the results of the crops grown on a commercial scale were as follows:

1. *Sugar Percentage.*—This was about the same as that of the German and Dutch beets handled simultaneously at the factories.

2. *Yield.*—The Hollandia Company's crops for some 250 acres averaged 7·9 tons, washed weights. The agent says that five farmers who spent no more than £10 an acre on their crops, had " between 5 and 14 tons per acre, making an average of 10 tons," washed weights. In the return reproduced on a previous page five men are shown as having produced 10 tons, one as having grown 11 tons, and a third as having marketed 12 tons. The Arnhem Company's crops averaged 9½ tons with from 10 to 12 tons on suitable land and with fair treatment. These are railway, not washed weights.

Mr. Cohen states that on 30 acres as much as 12½ tons washed weights were grown. The details have not been published.

With experience and normal conditions, the Hollandia agent and growers anticipate higher crops than the highest obtained, the Arnhem contractor from "14 to 16 tons" (railway weights), and Mr. Cohen 15 tons washed weights, "on a very conservative estimate."



Distribution of Sugar in the Beet.

It is evidence of the immense amount of study that has been given to the subject of beet culture on the Continent that there is a literature merely on the problem of the distribution of sugar in the beet root. One of the latest diagrams by P. Schubart is reproduced. It has been called the quintessence of all the work done on the subject.

The conic outlines indicate the rich sugar zones; the figures give the sugar percentages. The result appears to be that the zone richest in even sugar is near the sides of the root.

Another point brought out by the diagram is the necessity for topping with great care—that is, cutting away neither too much nor too little of the top.

CHAPTER X

HOW SUGAR BEET OUGHT TO BE GROWN: ROTATIONS AND DEEP PLOUGHING.

"Little was known of the suitability of the land for beet growing, and less was known of the methods of cultivation required."—*Progress of the Sugar Industry in the United States.*

Plain Talk with the Would-be Beet Grower.—An American authority on the beet crop writes that the successful grower must not only be willing to adopt new methods and new tools if necessary,

> he must be willing to accept suggestions from those who have had experience. He must study carefully the relation of this new crop to his general practice in regard to rotation, fertilisation, soil preparation, stock feeding, &c. If he intends to grow beets extensively, he must also be able to handle labour to the best advantage.

The fact that a farmer can grow 100 acres of wheat successfully is not an indication, as another Transatlantic writer says, that he can plant 50 acres to beets and make them pay:

> The sugar beet is a plant by itself, with its own peculiar needs; but it is not an experimental plant. Back of its successful culture of to-day lie a hundred years of experiment, and practically all the problems that the grower will meet have already been met and solved

by those who have gone before him. In no other branch of agriculture is there a more splendid heritage of definite knowledge. The grower who masters this knowledge is perfectly equipped before he enters the field, and his chief consideration is the faithful application of methods already proved to be successful by those who have preceded him.

He must first of all have confidence in the factory management and respect for the factory agriculturist. It is proper that he should use his reason in studying sugar beet problems; but there are some things he must take on trust. The farmers' interests and those of the factory lap one another and intermingle in such a way that it is impossible for either to achieve the fullest success without the mutual confidence and esteem that are expressed in the phrase "team spirit." Both must pull together for the common interest of all.

Carelessness and inattention to details are a prolific source of trouble to the beet grower. Especially at the time of bunching and thinning he must look alive and push his help to the greatest activity and the most scrutinising care. These earliest weeks in the young plant's life are of the utmost importance to the success of the crop, and they will test the capacity of the beet grower to the fullest.

The growing of sugar beets is more properly horticulture than agriculture, and for this reason, if for no other, demands much more attention to detail and more intensive culture than any agricultural crop. The sugar beet is a delicate, high-bred plant, and will resent very decidedly any neglect by immediately showing a reduction in tonnage, sugar content, and purity.

Rotations.—It has been repeatedly asserted in England that beet can be grown year after year on the same ground. The best practice seems to be, however, to grow the crop in rotation. Reduction in size and in sugar content, disease and "beet sickness" are all spoken of as following upon reckless repetition of the crop on the same ground.* "In a few instances, it may be admitted," writes Dr. S. L. Jodidi in the latest American publication on sugar beet growing, "farmers may get good crops for several years in succession, but on the whole a system without rotation is not prudent, and will give in the majority of cases smaller tonnage and poorer beets." The *Journal of the Board of Agriculture*, says: "The beet should only be grown on the same land once in three or four years."*

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* "The beet is specially prone to attacks of animal and vegetable parasites."—E. Koppeschaar, *International Sugar Journal.*

HOLLAND—The representative of the Arnhem Company has addressed Norfolk farmers as follows:

> Beet is by preference a rotation crop. In some countries they rotate every two years, in others every three years, the latter course being preferable, as it keeps the ground in the best condition without applying extra quantities of manure or special treating.

Another Hollander draws attention to the fact that rotation is practised in the case of every kind of crop grown and asks why beet should be an exception. He urges that it should not be grown oftener than once every four years on the same ground. On the other hand, the handbook circulated by the East Anglian Sugar Company said:

> One of the great advantages of sugar beet cultivation is that the crop may be raised from the same field year after year.

The Hollandia Company also believes that "with modern manuring the crop may be grown year after year," but states that "the practice in Holland is to change the crop." The English farmer will undoubtedly believe in growing sugar beet in rotation.*

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* Mr. Schobloch sends me the following note from a lecture by Prof. Hollrung: "On light and medium soils, beet, oats, rape, and cabbage should not be grown more than once in four years. The nematode attacks all these, but not potatoes. Soils with much humus are more liable to attack than clays. The infection may be brought by seeding implements, and even by saturated lime from factories."

France, Austria, and Belgium. — The rotations commonly observed in various countries which grow beet follow:

> In the rotations chiefly followed in France (says the *Journal of the Board of Agriculture*, from which the following French, Austrian, Belgian, and German tables are taken) beet leads the rotation, and is manured, wheat following it. In order to provide a better division of labour, give more time for tillage operations, and permit the keeping of more stock and the improvement of the soil by the growth of leguminous crops, the following rotation has been suggested: Beet, oats, clover, wheat. This rotation, on the other hand, exposes the oats to "lodging," while it does not give a sufficiently important place to wheat.†

	France.		Austria.		Belgium.
Year.	Nord.	Pas-de-Calais.	Bohemia.	Bohemia—Moorland Soil.	Hainault.
1st	Beet	Beet	Beet	Beet	Beet
2nd	Wheat	Wheat	Spring cereal	Straw crop	Wheat
3rd	Oats	Oats	Beet	Beet	Oats or rye with clover
4th	—	Clover and annual fodders	Spring cereal	Straw crop	Clover
5th	—	—	Red clover	Fodder crop	Wheat or winter barley
6th	—	—	Winter cereal	Straw crop	—

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* *See* page 101.

† Oats are objected to as a crop to precede beet as they are attacked by the same nematode. *See* page 101.

GERMANY.—Here is the German table with the *Journal's* notes:

Year	Saxony.	Magdeburg.	Hanover.	Saxony.	Posen.
1st	Sugar beet	Sugar beet	Potatoes with dung	Lucerne—four years	Winter cereal.
2nd	Potatoes	Barley or oats.	Sugar beet	Potatoes	Sugar beet or potatoes.
3rd	Winter cereal	Clover, peas, or vetches	Winter cereal	Wheat	Barley or oats.
4th	Sugar beet	Wheat	Oats or barley	Sugar beet	Rye.
5th	Spring cereal or peas	—	—	—	Sugar beet or potatoes.
6th	Winter cereal	—	—	—	Potatoes.
7th	—	—	—	—	Barley or oats.
8th	—	—	—	—	Clover.

It is clear that the rotation must vary widely according to the particular circumstances; thus, in beet growing districts the area occupied annually by this crop varies from 11 to 33 per cent. of the farm. Hitier recommends the adoption of a rotation in which lucerne or other leguminous fodder crop takes a large place, in order to bring the sugar beet crop to a just proportion, avoid the increase in fungus and insect pests, and permit the maintenance of a large head of stock to produce dung. Long rotations are sometimes practised; thus, in Saxony a rotation followed on some of the better sandy-loam soils is: Beet with dung, wheat, rye, potatoes with dung, oats with clover, clover, wheat with dung, sugar beet, barley, rye, sugar beet with dung, wheat.

It is believed in Germany that beets after clover are usually attacked by insects and also ripen later, but Kiehl found, on the basis of fourteen years' observations, that sugar beets after clover gave a considerably higher average yield than beets after wheat. The fourteen years' average was as follows :

After wheat ... 11·10 tons per acre with 1·60 tons of sugar.
,, clover ... 12·27 ,, ,, ,, 1·73 ,, ,,

This shows a greater average yield of 1·17 tons of beet containing over 2½ cwt. more sugar after clover than after wheat.

The following account of the German system is given in an American beet sugar journal :

> The plan used most largely by German beet growers is the four-field plan. The land adapted to beet growing is divided into four fields, which are worked on a four-year turn as follows :
>
> (1) Winter crops, with 20 tons stable manure per acre.
> (2) Sugar beets, without manure.
> (3) Summer crops, with 12 tons stable manure per acre.
> (4) Clover without manure.
>
> This plan is maintained year after year. Some farmers go further and sub-divide each section into two fields, alternating with two kinds of winter cereals or two kinds of leafed plants, as the case may be. The effect of this rotation has always been to largely increase the yield of cereals as well as of roots.

In Hungary, beet usually follows a well-manured wheat crop.

Denmark.—Mr. Rider Haggard, describing in the *Times* a field of beet in Denmark, 180 acres in extent, says :

> This farm is divided into eight fields of the same area—namely, 180 acres. The rotation followed on it as follows : (1) Wheat ; (2) Sugar beet ; (3) barley ; (4) sugar beet again ; (5) oats ; (6) barley sown down with clover ; (7) clover, half of which stands two years and half of which is fallowed in the second year, thus allowing one fallow of all the land in sixteen years in order to rest it and exterminate weeds.

United States.—American experience has shown that beets should not be grown on the same piece of ground oftener than once in three years.

A Fine Example of the Klein-Wanzleben Sugar Beet

Its tail has been cut off by the photographer. There are three principal kinds—E, N, and Z. E, the first, which is late maturing, is suitable for dry climates. N and Z have been used in, and are suitable for, England. N gives a good yield, with a high sugar content, and does well at Klein-Wanzleben. Z has a smaller yield, but a high sugar content

Mr. Koppeschaar, writing for English readers, says that though heavy beets have been grown after clover, experience is that they have an increased weight at the expense of the sugar content.

As to the after crop following on the beet crop, summer wheat will take first place, followed by oats (if free from nematodes),* peas, and barley. For winter wheat it will be generally too late. Thus, for example, a good rotation would be clover, wheat, sugar beets, summer barley, or peas. Farmers should study this matter in the light of their special circumstances of soil, climate, and the like.

In England, of course, wheat always follows clover, and pays best.

The Deep-Rooting Beet.—The next thing of importance is thorough cultivation. I have heard a well-known agricultural experimentalist say that he has know of cases in which the roots of the mangel have gone down deep enough to stop up drains. But as the body of the beet is already in the ground and not on the surface like the root of the mangel, the roots of the beet may be assumed to go down into the soil farther still. Beet plants examined by he

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* Succession of Beet Crops.—"In Germany, too close a succession of beet root, cabbage, oats, &c.," Mr. Schobloch writes to me, "has caused considerable damage in wide districts, because of the nematodes. Nevertheless some growers cultivate beets every third year. This is only safe where a big area is alternatively put down to sainfoin. Another method, which is in limited use, is to grow beet every second year alternatively with potatoes. In this case the ground is entirely taken out of the main rotation, and the sub-rotation is kept up until nematodes prevail and crops decrease, when the land is given back to the main rotation. The potatoes are grown with farmyard manure, and artificials are used on the beet. In exceptional cases, where the ground remained free from disease, this sub-rotation has been kept up for nearly a generation and the crops have increased. To grow beet in direct succession I cannot recommend, because beet root leaves the soil in bad preparation for itself. If the sub-rotation is to be one of three years, let barley follow beet."

North Dakota station at maturity, or 135 days after planting the seed, showed a deep root extending almost perpendicularly downward into the ground, the lower part being quite small and threadlike and reaching to a depth of more than 3ft., and the lateral roots starting 4in. or 5in. from the surface with but little root development in the upper 6in. of the soil. The greatest amount of branching and fibrous growth of beet roots took place in the space between 8in. and 14in. in depth.

It is well known that the shape and the sugar content of beets bear a close relation to each other, and shape is obviously affected by cultivation.

In a field of beet near my house a wide hole had been dug in order to extract clay. It was filled up with road mud. The excellence of the beets grown over the site of the hole was remarkable. Note also the high return from a piece of dug land mentioned in the last Chapter. (The finest parsnips I ever had were from waste seed which happened to have been thrown out on a high pile of clay obtained by the excavation of a tank.)

Deep Ploughing.—The deepest possible cultivation and good draining are undoubtedly essential to the production of the best beets. "In Germany," writes a high authority in that country to me, "deep ploughing is practised throughout the districts where beets are grown, the fields being ploughed from 12in. to 14in." "The land" (the Maidstone delegates wrote of what they saw in Germany), "varies considerably, from a light-moving, dark-coloured loam to a dark, very stiff loam. The lighter lands are ploughed to a great depth, about 12in., but on the heavier lands about 7in. to 8in. suffices." "Growers will find that when the season is dry some roots will go down to the depth of a yard and more," I see another German authority says, "but if the necessary ploughing can be done from 12in. to 14in. deep, beet will grow all right." Deep ploughing is certainly practised in Holland. One Dutch authority, writing for English readers, advises that autumn ploughing and winter furrowing in our heavy clay soils should be "confined to the moderate depth of, say, 12in."

"Under all conditions," says the *American Sugar Beet Growers' Annual*, "deep preparation of the soil is a *sine qua non* of successful sugar beet culture, nothing having been more conclusively shown than that sugar beet cultivation with shallow preparation of the soil can never be satisfactorily practised for any great length of time."

> A quick penetration of the root into the subsoil (it goes on) is of the utmost importance to a proper and healthy development of the plant, and to secure this the most effective ploughing must be done in the fall, so that the new layer of soil brought to the surface may be the better acted upon by the atmospheric agencies to render the plant food available. This ploughing should be done in the fall, should be deep, say to a depth of 10in., and should there be the slightest tendency toward a hard-pan it should be subsoiled to a farther depth of 6in. Should the land not have been previously subjected to deep cultivation, it would be advisable to make the regular ploughing more shallow and subsoil to a proportionate depth, thus not turning up too much of the raw soil.
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> Where a gradual deepening of the soil has been introduced methodically, it is permissible to plough to the full depth without having cause to fear that dead layers will be turned up. Where this is not the case the plough should be followed up by a subsoil plough. Such soils as can be prepared for deep culture only by deep subsoiling for many years are not beet soils. Nevertheless, it is advisable to use the subsoil plough for a while where beet culture is being first introduced, and upon loam soils, if the soil has not been previously deepened sufficiently. In good old beet soil we plough to 16in., but the winter furrow is generally made 13in. to 15in. Where beet culture is being introduced it is sufficient to turn the soil 10in. to 12in., but in each successive ploughing the soil should be systematically deepened.

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> Beets that had been planted in fields which were ploughed deep gave crops that for nine years averaged 26 per cent. greater. The effect of deep ploughing, especially with steam ploughs, is noticed three to four years. In the dry year 1889, in the dominion of Keczkemet, in Hungary, beets planted according to the usual methods gave no crop at all, despite repeated plantings, whereas beets planted in deep ploughed fields gave a good average crop.
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> Deep ploughing is an element by which the great differences in dry years can be equalised. A majority of observations show later ripening in deep ploughed fields, which proves a greater production, since, in order to form organic substances, there is need not only of a larger amount of nutritive matter, but also of heat and light, and, hence, more time. Although these increased crops. which are based upon official data, cannot be looked upon as the result of deep culture alone, since intensive manuring also plays a great part, still deep ploughing must be looked upon as a principal factor, since, without this element, the most abundant manuring cannot produce such crops.

Newlands says roundly: "All soils incapable of being cultivated to a depth of at least 16in. are unsuited for beet."

One result of shallow ploughing is that at harvest many beets are found to be standing out of the ground, and heavy tops have to be cut off. Mr. A. D. Hall, while agreeing that mangel land may be good beet land, adds:

> It is, however, desirable to attain a deeper and more mellow tilth, since so much of the value of this crop depends upon its quality. It is very necessary for sugar-making to obtain shapely roots, free from forking, and this means a mellow deeply-worked soil. All foreign cultivators insist upon the importance of subsoiling, but this should take place before the winter, so as to give the land time to settle down and consolidate before sowing. If farmyard manure is required it should be spread on the stubble and ploughed in at an early date in the autumn. The best preparation will be to follow up this ploughing, which should be 6in. to 7in. deep, with a subsoiler, working down to another 8in. or 10in.; and then by a cross ploughing as soon as the land can be worked in the spring, after which it is only

necessary to use the cultivator and harrow to work the land down for a seed bed. It is very important to get the first ploughing done in good time before the winter.

The advice given in the *Journal of the Board of Agriculture* is:

> The stubble should be ploughed to a depth of 10in. or 12in. in October or November, the special objects in view for sugar beet being to ameliorate the soil, conserve moisture in the subsoil, and destroy weeds. Where such deep ploughing is inadvisable owing to the risk of turning up a poor subsoil, then a subsoiler may follow or be attached to the plough in order to break the land as deeply as possible.
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> The ploughed stubble is left to the ameliorating influences of the winter frosts, and in spring an endeavour is made to obtain a well-worked, mellow seed-bed. Strong loams may need a second ploughing in spring, but, generally speaking, cultivating and harrowing will be sufficient to provide a well pulverised seed-bed, and in dry seasons the Crosskill roller will do good service. When possible there should be an interval between the general preparation and the final harrowing in order to encourage weed seeds to germinate, the seedlings being then destroyed before the sugar beet seed is sown.

There is, as we all know, no more contentious subject among farmers than deep ploughing. Given the fact that beet requires deep cultivation, intelligent agriculturists can no doubt be trusted to know by what method this can best be obtained in the case of their particular soils. The author of "La Betterave à Sucre," after urging all the advantages of deep ploughing, insists that it shall be done with "extreme prudence," that is, gradually.

CHAPTER XI

HOW SUGAR BEET OUGHT TO BE GROWN: SEED AND SEEDING

Differences in Seed.—The thing on which experienced growers abroad set importance, after soil and rotation, is the right seed. Through neglecting to obtain seed of the right sort many tons of fodder beets were grown in Essex in 1910. An agriculturist belonging to another county discoursed in public on his lack of success in beet growing, and it appeared that he had been growing sugar mangel.

It must not only be sugar beet seed, but seed from varieties which have been improved to the utmost. Each factory will probably supply seed to its growers. The seed issued on behalf of the Arnhem Company was Klein-Wanzleben. Mr. Cohen distributed three varieties in 1910, but in 1911, it appears, Klein-Wanzleben only. The Hollandia Company writes to me approving of Klein-Wanzleben and of the seed grown in Holland, "because it is grown under climatic conditions very similar to those prevailing in England."

A great deal has been written on the different varieties of seed, but as the first English factories may reasonably be depended upon in their own interests to supply the best and most suitable seed, the matter is not perhaps a particularly urgent one for English growers. The question of seed has caused difficulties in some parts of the Continent, however, and in 1910 there was a complaint in the Eastern Counties—I know not with what justification

—as to some of the seed distributed.* On the other hand a correspondent tells me that "the seed was splendid and of wonderful germinating power."

Varieties.—The best known beet is the White Silesian, named after Silesia, in which the first beet factory was established.

"It is no longer cultivated," says Vilmorin, "but half a century ago was almost the only variety in use. It contained about 11 per cent. of sugar, and served as the starting point, in France and Germany, for the breeding of beets rich in sugar. A second class of varieties, of large yield in roots and average richness in sugar, is almost wholly French in origin." "From these two groups, but particularly from the first," Malpeaux writes, "have come the numerous varieties which differ in shape, size, flesh texture, leaves, and sugar percentage; and now completely take the place of the early types. These varieties have been obtained in France and Germany. [The Wohanka sorts come from Austria.] All the French varieties cultivated before 1884 have been replaced. When there are so many rich varieties the best does not exist. Experience must have the last word. The best varieties are those which best suit the conditions in which they are to be grown. Large farms can have different varieties adapted to differences of soil and diverse factory requirements. Progress in beet growing has been due for many years past to the utilisation of varieties in the soils most congenial to them."

Klein-Wanzleben—there are many varieties—is identified with richness in sugar and is very productive. It grows almost level with the surface of the soil and is tapering.

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* "I found it to be in most cases of very inferior and mixed quality."—F. F. Kemp, *Land Agents' Record*, March 4, 1911.

It is "most suitable for deep open soils in a good state of cultivation." Of the French varieties the best known are those of the Vilmorins'.*

Qualities of Good Seed.—It is of great importance to have seed not only of the right variety but in a sound condition. According to Schribaux, good "seed" (the "seed" of commerce consists of one to three or more true seeds imbedded in a woody capsule or fruit) should contain no more than 15 per cent. of water, and should possess a purity of 97 per cent. Of 100 "seeds" or fruits, 60 at least should germinate within five days, and 80 after fourteen days, while they should furnish about 150 healthy seedlings. Another test is as follows: Out of 100 sound seed balls there should be 135 good shoots in six days, and a total of 150 in fourteen days. The speed of germination

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* VARIETIES OF BEET.—The following lists are compiled from "La Betterave à Sucre":

FRENCH.

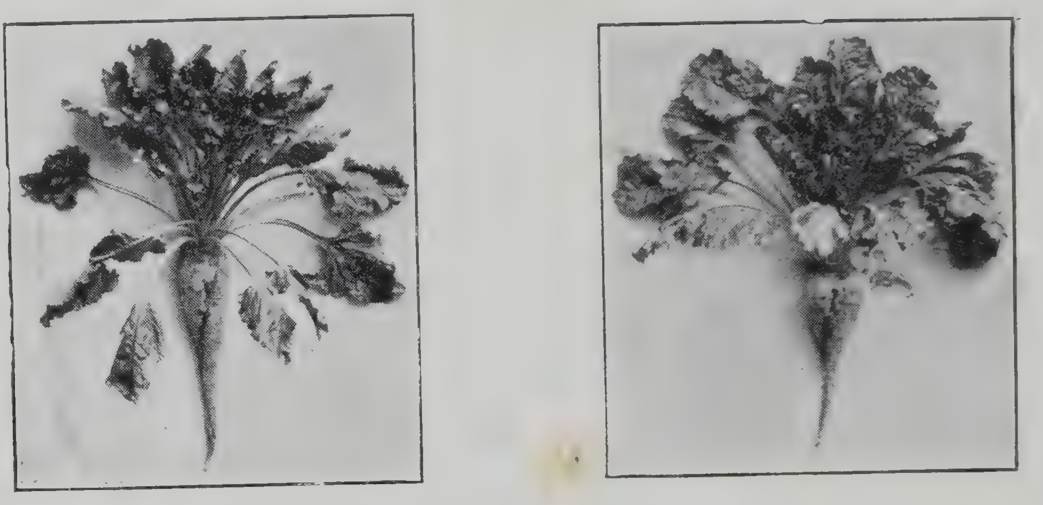
Blanche à collet rose.
Blanche à collet gris.
Blanche à collet vert.
Bouteuse.
Blanche Ameliorée Vilmorin.
Française riche.
(Fouquier d'Hérouel).
Simon Legrand.
Fl. Desprez.
Demiaulte.
Hary.
Dennetière.
Carlier.
Legras.
Eloir.
Laurent-Mouchon.

GERMAN.

White Silesian Rosetop.
White Magdeburg.
Imperial.
Improved White Imperial.
Improved Rose Imperial.
Electoral.

The above are not now in use. Klein-Wanzleben is the most widespread, and is produced by Strube, Dippe, Schreiber, Henri Mette, Otto Breusted, and Dr. Bergmann.

The names of other varieties appear in the Appendix. Most of the seed sown in France is of German origin.



Two Wohanka Beets.

Rich, early maturing type, for good deep soils

Heavy yielding, later maturing type, for shallow, poor soils

Drilling Beet near Magdeburg

Drying Beet Seed in Bohemia

is of great importance, quick germination indicating good sound seed. The chief items in the standard of the Association of the German Sugar Industry are (Knauer and Hollrung, 1906):

1. One kilogram (2·2lb.) of sugar beet seed must yield at least 70,000 seedlings in fourteen days.
2. Of these at least 46,000 must have germinated in six days.
3. Of 100 " seeds," or fruits, 75 must have germinated.
4. The water content is normal up to 15 per cent. inclusive; the seed is saleable up to 17 per cent. inclusive, but from 15 to 17 per cent. the extra weight of water must be made good.
5. Foreign substances are fixed at not over 3 per cent.; seed containing up to 5 per cent. of foreign substances may be sold, but from 3 to 5 per cent. the excess of weight of such foreign matter must be made good.
6. Infraction of only one of the clauses 1—5 renders the seed unsaleable.

Good seed should weigh from 20lb. to 22lb. per bushel. For the rest, the tests applied to mangel seed may be applied to beet seed.

Qualities of Good Beet.—The following qualities are particularised by Knauer and Hollrung as distinguishing a good variety of beet:

1. Slender form, lightly drawn in about half-way down, with a moderate length for the whole bulb.
2. Somewhat spirally twisted root grooves (*Wurzelrille*).
3. A small top, not appearing above the surface of the soil, and resembling a truncated cone of about 45 degrees gradient.
4. Short stemmed leaves, which are not too small, but rather broad, lightly waved, and standing at an angle of about 45 degrees from the bulb.
5. Little susceptibility to conditions leading to " bolting."
6. Considerable power of retaining the greater part of the non-sugars in the leaves.
7. Exceptional disposition to build up material, especially the separation of sugar.

Newlands' points may be summarised thus:

1. Regular pear-shaped form and smooth skin.

2. Non-forking.

3. White and firm flesh, delicate, uniform structure, and clean sugary flavour.

4. Average weight, 1½lb. to 2½lb. (*Vide* later paragraph.)

5. No tendency to become necky.

6. Good beets are considerably denser than water, and rapidly sink to the bottom of a vessel filled with water. The greater the specific gravity the greater richness in sugar, as a rule. A still better test is the specific weight of the squeezed-out juice. It should vary between 1·06 and 1·07. Very rich roots' juice rises above 1·07. (For estimating the specific gravity of juice the hydrometer is used.)

7. Under good cultivation a good beet should bury itself. Stones or a stiff clay on an impervious subsoil may prevent proper burying.

Quantity and Quality.—On the subject of the weights of beets Newlands says:

> As a rule, beets weighing more than 3½lb. are watery and poor in sugar, and very small roots, weighing less than ¾lb., are either unripe or too woody and in either case yield comparatively little sugar. As the soil and season have a great influence upon the composition of the crop, it is quite possible in a favourable season, and with proper cultivation, to produce beets weighing over 4lb., which nevertheless yield a good percentage of sugar. Speaking generally, good beetroots in average seasons seldom exceed 2lb. in weight.*

Depth to Sow.—Continental authorities attach considerable importance to the way in which the seeding of beet is done. It will have been noticed that Mr. Cohen has imported Dutchmen and Dutch machines to do the seeding in Norfolk.

The advice which was given in 1910 that beet seed should be put in at from 1·2in. to 1·6in. deep, "as recommended by Bricon, Tzebinski, and others," is not supported by the following opinions:

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* The subject is also discussed on pages 78 and 79.

East Anglia Company's handbook: Not more than ½in.

Journal of the Board of Agriculture: About ¾in

Grouven: ½in.

Walkhoff and Achard: About ¾in.

Frühling and Wolsey: As superficially as possible, but a little deeper if the soil is light.

Percival: Not more than 1in.

U.S. Department of Agriculture: ¾in. to 2in., according to soil conditions; shallow planting in moist soil.

Mr. Sawyer reports that the Dutch expert in Norfolk drilled "to English ideas, very fleet, the seed hardly being buried at all, and certainly not more than an inch underground."

Dr. Diedrich Meyer, of the station for agricultural chemistry in connection with Halle University, says "seeding should be done no deeper than is necessary to make sure of good germination, because warmth and air are needed by it as well as water. Therefore the seed may be put in more deeply in light, warm soils than in cold clay ones."

Professor Malpeaux, Director of the Agricultural College, Pas de Calais, says about ⅘in. is the ideal depth, or, in light and dry soils, 1in. to nearly 1½in. The peasants say the seed "should be able to see its sower passing and to hear the Angelus!"

As in the case of mangel, there is a difference of opinion as to whether the seed should be soaked or not. A Wohanka bulletin says the air-drying of seed a few days before sowing "will always result in quicker germination and more vigorous growth."

The question of milled seed is discussed in the Appendix.

The plant ripens from 140 to 150 days from seeding.

Weight of Seed to Sow.—The quantity of seed used depends on the date, the soil, and the weather. From 18lb. to 26lb. are drilled in France and from 26lb. to 35lb. in Germany. The Westphalian farmer, whose balance sheet is given later, uses from 20lb. to 25lb. Mr Schobloch, the author of another balance sheet, says 28lb. The U.S.

Department of Agriculture's Report gives "from 15lb. to 20lb." The Hollandia Company recommends from 12lb. to 13lb. It supplied 14lb. in 1910, and an experienced farmer told me this was "superabundant."

Another agriculturist well acquainted with the Eastern Counties writes to me that "too much seed seemed to be sown." Mr. Cohen's Dutch expert advised 15lb. to 16lb.

The amount of seed sown depends, of course, primarily on the physical condition of the soil. An excellent stand of wheat may be got from 5 pecks, and in other circumstances it may be desirable to use 10 pecks. In the case of mangel seed from 10lb. to 14lb. used to be sown, while 5lb. to 7lb. is now usually thought sufficient.

The Distance Apart.—In Germany the distance between the rows is said to vary from 14in. to 18in., with the beets from 8in. to 12in. apart. In France the distance is reported as from 16in. to 18in., with the beets from 10in. to 12in. apart. In Denmark Mr. Rider Haggard "measured them with a rule and found they averaged 15in. from row to row, and 8in. from beet to beet." Percival says 14in. to 15in. between rows, with the plants singled to 6in. or 8in. Schack-Sommer proposes 18in. to 20in., owing to the difficulties experienced in horse-hoeing with about 8in. between the plants. One writer for English experimenters has suggested 14in. as the distance between the rows; he advises that the beets should be chopped out into bunches 12in. apart, which are finally reduced to a single plant each. Another says 12in. and advises never more than 16in. between the rows, with 9in. between the plants; "the richer the land the closer the plants should be left when singling." The Hollandia Company at first suggested 13in. apart and singling to 12in. Later on it advised 15in. to 21in., "which should allow for horse hoeing" and chopping out to 10in. apart. A correspondent in Holland writes:

> A distance of 12in. to 14in. is necessary for proper growth. If the plants are left too close together in the row, the beet may find nourishment in the ground and shoot its roots as deep as beets with wider spaces in the row. But its other organs, the leaves, will not be able to develop properly, and the beet will live a crippled life, and fail as a good sugar producer. The more room the bigger roots and the healthier plants, and therefore the more leaves, and consequently the more sugar.

Mr. Cohen's expert sowed 13in. to 14in. in the rows, to be singled to about a foot apart.

A writer in the *American Sugar Beet Growers' Annual* says that where the land is rich and moisture conditions are good, from 16in. to 18in. is advisable, leaving the plants from 6in. to 8in. apart in the row.

1. The farther apart the beets are planted the larger grow the roots.
2. The development of top as compared with root is increased with the space between the plants.
3. The yield is smaller when the plants are either too close or too far apart.
4. Beets grown in close rows and close together in the row generally carry a higher sugar content and purity than when the space is wider—a fact which is of great moment to the factory and to the grower when payment is made on the sliding scale.
5. Moisture is conserved to better advantage by close planting.

Pagnoul's conclusions, after eight years' work, were that close planting gives beets which are (1) richer in sugar; (2) better in quality; (3) larger in yield; and (4) less exhausting to the soil. The distances he experimented with were 17in. and 20in.

Beets at small distances, while producing more sugar, absorb less saline matter, and are therefore less exhausting to the soil.

Corewinder, Landereau, Mariage, Pellet, Déhérain, and Vilmorin have come to similar conclusions, which are also to be drawn from the following results obtained at the experiment station in Minnesota so long ago as 1898:

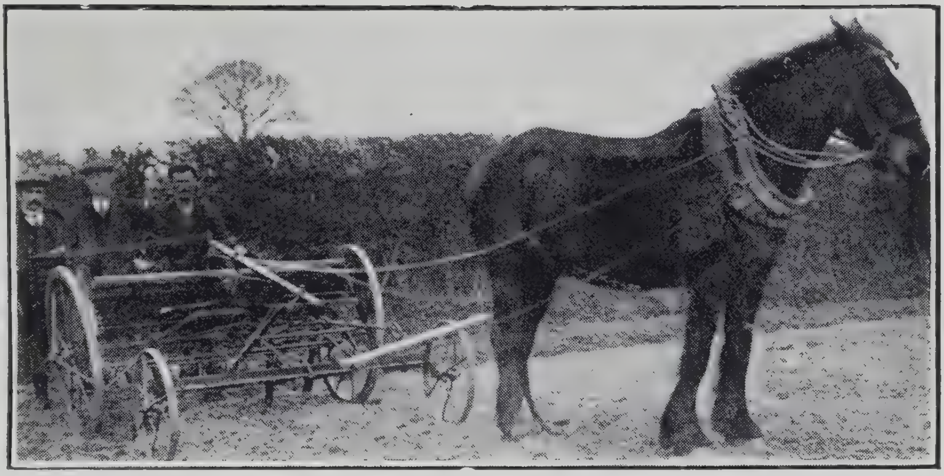
AVERAGE OF 8 PLOTS.	SUGAR PER CENT.	PURITY.	TONS.
Rows 14in. apart	16·7	85·5	16·8
Rows 18in. apart	16·7	87·1	16·9
Rows 24in. apart	16·3	87·0	15·9
Rows 30in. apart	15·6	84·8	16·5

At the Wisconsin station the following average results were obtained from four plots:

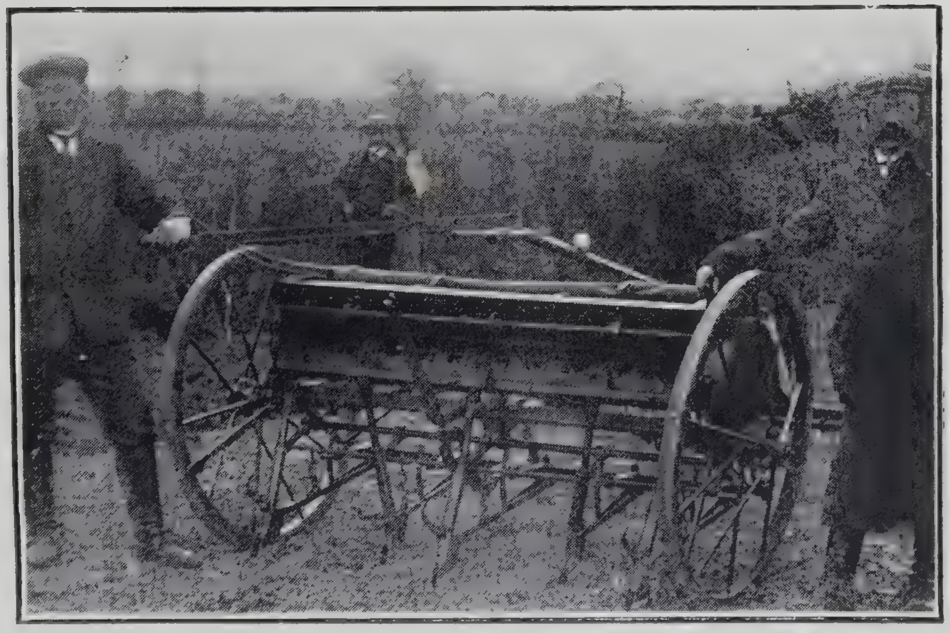
DATES.	ROW SPACE.	SUGAR.	PURITY.
Sept. 5	20in.	11·56	78·0
Sept. 5	30in.	11·30	76·0
Sept. 15	20in.	12·79	82·0
Sept. 15	30in.	10·73	75·6
Sept. 22	20in.	14·27	83·0
Sept. 22	30in.	13·86	84·6
Sept. 30	20in.	15·12	84·6
Sept. 30	30in.	15·04	83·9
Sept. 30	20in.	15·12	84·6
Sept. 30	30in.	16.33	85·1
Oct. 7	20in.	16·33	85·1
Oct. 7	30in.	14·42	83·0
Oct. 16	20in.	14·97	84·9
Oct. 16	30in.	15·27	82·1
Oct. 23	20in.	16·03	85·9
Oct. 23	30in.	15·21	82·1

In Illinois similar experiments were conducted which gave the following results:

ROW DISTANCE.	SUGAR.	PURITY.
15in.	15·1	84·5
18in.	15·6	82·7
22in.	13·6	82·0
28in.	12·3	80·4



FRONT VIEW OF THE DUTCH BEET DRILL IMPORTED BY MR. COHEN



BACK VIEW

For description, *see* page 163. The seed was drilled April 19—21, and the hoeing machines began work May 24—25, or a little more than three weeks after

The Nebraska station reports that the results of three years' experiments show quite conclusively that 18in. is the most satisfactory distance. "With a greater distance between rows the capabilities of the soil are not fully utilised, while if rows are closer than 18in. it is not possible to make use of horse cultivation. Ten years' experience goes to show that the distances should be from 16in. to 20in."

The American Beet Sugar Company advises 18in. rows and 8in. apart, or 16in. rows and 9in. apart, but adds: "We cannot advise an arbitrary distance, as much depends on the productiveness of the land and on the evenness of the stand."

It will be seen that these American tables do not show uniform variations in sugar and purity according to distance. Several writers have suggested that the distance should be "inversely proportional to the richness of the soil."

Mr. Trustram Eve, the Secretary of the Farmers' Club, who, in view of his extensive acquaintance with English agricultural conditions, speaks with authority, writes to me:

> The width of the rows caused nine-tenths of the Essex trouble.
>
> In my opinion, 21in. is the minimum width in which a horse or cob can walk without damaging the beet plants. I went over a large area of beet in 1910. I took actual measurements in a field where a man was horse-hoeing, and I have my notes before me. Of course, the actual width of the rows must be such as would fit the points at which the drill can be altered, and this is a practical point that farmers have to consider. Suppose, for instance, it was laid down that they must be, say, 17in., it would very likely be impossible with an ordinary English drill to fit the coulters to this distance.
>
> In my opinion, 21in. is a very tight fit for horse-hoeing, and, as far as convenience is concerned, 23in. would be better, but I do not

> think this would suit the beet so well. I feel very strongly on the value of horse-hoeing.
>
> If English farmers cannot horse-hoe they cannot grow beet, for they have no available labour for hand-hoeing between the rows.

Beet growers are evidently to be advised to use Continental drills and hoes, or English implements working in the same way. Mr. Sawyer tells me that Mr. Cohen's Dutch drill sowed 13in. and 14in. apart:

> It is a front-steerage drill with an ingenious connection which makes it possible for one man to steer absolutely straight and drive the one horse at the same time. As it has five coulters, it is possible to drill some 12 to 13 acres a day.
>
> The weeder or horse-hoe is made to travel across the drills and cut out the plants about 12½in. apart, to be finally singled by hand. The special points about it are its interchangeable ∧ hoes of different sizes, the way in which the wheels slide on the axle according to the widths drilled, and the patent rack-and-pinion steerage.

The following quotation is from Dr. Diedrich Meyer:

> More important even than the depth at which the seed is sown is the right distance apart of the rows and plants. A beet standing by itself grows very heavy, but is lower in sugar content. Beets grown far apart also keep on growing much longer and are often not ripe at harvesting time.
>
> On heavy soils the rows must be closer than on light soils. Late varieties—such as take a long time to ripen and yield a large weight of roots—must be kept close. When soil is heavily manured, the beets must be close. On good soils the distance between the rows should be 14in.; on light, 16in. to 17in.; the distance between the plants in the rows to be 9in. in the first case and 10in. to 11in. in the second. This will give 44,000 beets in the one case and 34,000 in the other per acre.

I learn from Dr. Rabbethge that in Germany 16in. is the general distance when horse-hoes are to be used.

A French writer says:

“There are factors too often neglected: on the one hand, the condition and richness of the soil and the variety of seed; and on the other, convenient horse-hoeing.”

Mr. A. O. T. Bennett writes to me:

The drills used in Germany are quite once and a half as large as ours and the horse-hoes were made to match. The distance they talk of here is all wrong. If our people want to grow sugar beet satisfactorily they must use the same kind of machines the foreigners do. This is where we in England go wrong; we are too prone to do things our own way and not benefit by the experience of other nations. It is no doubt a fine thing to be independent, but it would be better to accept the experience gained by others and then try to improve on it if we can.

I find from a German friend that his drill is about 8ft. 4in. wide and that he uses either 6 or 7 drill shares at a time, according to the nature of the soil; if heavy 6, if light 7. The rows are then 16½in. or 14⅓in. apart. The plants in the rows are apart about 10in. The hand hoes he uses are just about 9½in. for cutting out, and 7¾in. for using between the rows and bringing the earth near the plants. These are more handy than the larger ones and one can take more care with them.

The horse-hoes are the same width as the drills and do as many rows at a time.

I have heard of larger drills and hoes that are used on flat lands. As my informant's lands are rather hilly, he uses the common-sized drill. Mr. Cohen's machine seems to be of the size I mention, though the steering gear is not the kind I was accustomed to. It may be all right, but that of the German machine would appear to be more practical.

CHAPTER XII

HOW SUGAR BEET OUGHT TO BE GROWN: THE YEAR'S OPERATIONS

Advice from Holland.—The following programme of operations for beet for the whole year I summarise from information contained on various pages of the handbook prepared for the guidance of East Anglian growers already referred to:

October-November. Deep ploughing; manuring (6-8cwt. super., 6-8cwt. kainit).

April. Harrowing; rolling.

April-May. Drilling (April 15-May 15, 15-21in.); ¾cwt. nitrate; rolling if weather is dry.

May (about three weeks after drilling). First hoeing.

June (two weeks later). Chopping out to 10in. apart; ¾cwt. nitrate; singling to about a foot apart; (two weeks later) 1½cwt. nitrate.

June-July. Fields to be kept in good condition by hoeing.

September-October. Raising crop.

The "Instructions for Farmers" issued in typescript to farmers by the Hollandia Company were as follows:

The fields allotted for beet next year are ploughed about 8in. deep in October or November. It is most desirable to do it in October or November, but in cases of necessity it can be done early in the following year.

At the end of April the land is harrowed, after that flattened with a stone roll. At the end of April or beginning of May the seeds are by means of a drilling machine sown in rows 13in. apart.* After

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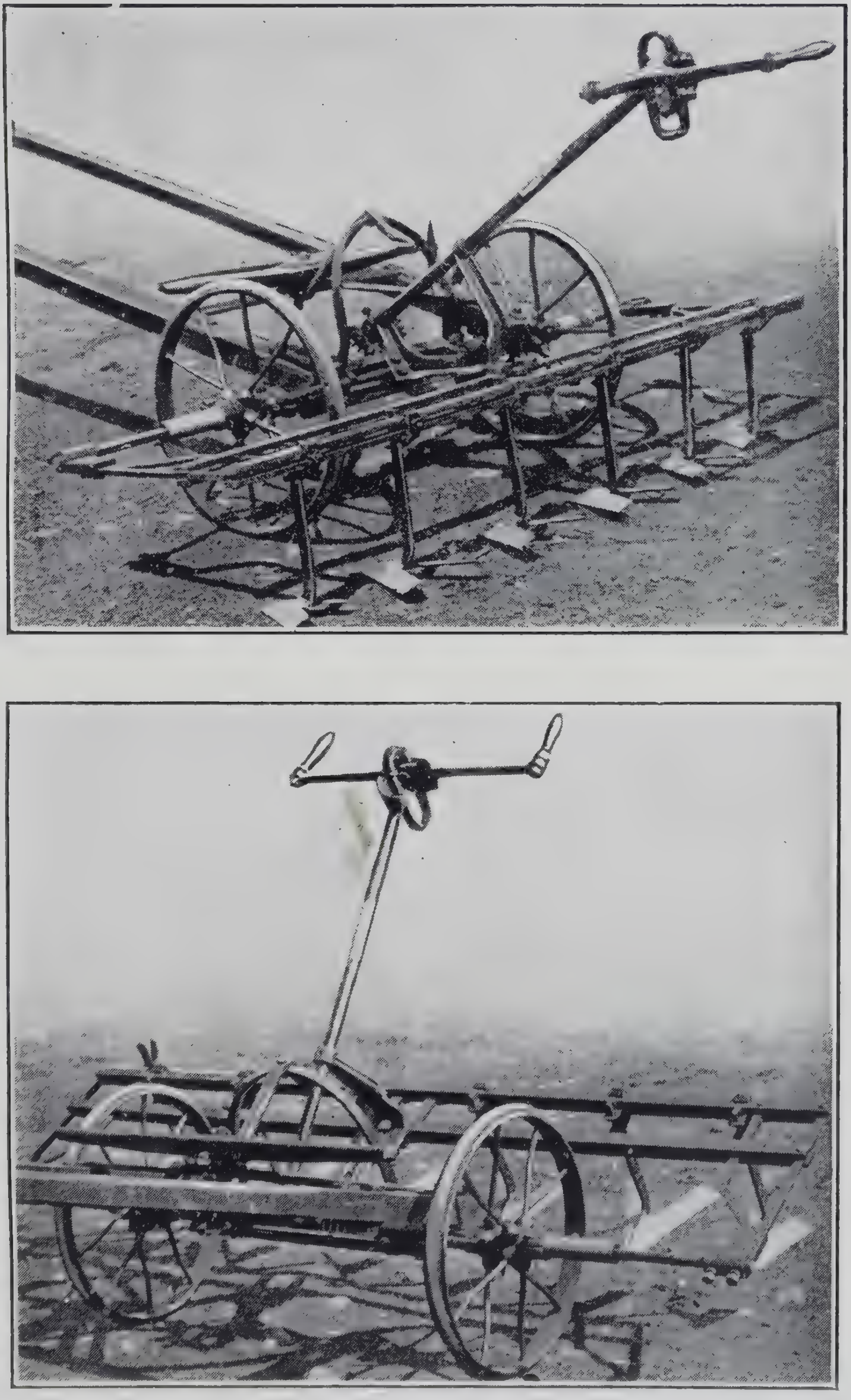
* The distance was extended, as already stated, to 15-21in., with the plants 10in. instead of 12in. apart.



Back and Front of Dutch Hoes Imported by Mr. Cohen

See pages 162—3. Mr. Cohen says that if experience shows that another type of implement is more efficient, there is no reason why it should not be adopted

that the fields are rolled again. All this has to be done in fine and dry weather. If not possible then, the last rolling has to be left out. As soon as the plants come out properly, so that they are well visible in the row, the fields must be weeded. About a fortnight after the weeding the plants are chopped out into groups of three or four, the groups remaining at a distance in the row of about 12in.

Immediately after chopping out is finished the groups must be thinned to one plant. The best plant of the group is preserved. The two or three weaker ones are pulled out. The remaining one is pressed in by hand, as the pulling out of the others may have disturbed the root.

A fortnight after the thinning the field is weeded again, and after that more or less regularly weeded in accordance with the conditions of the field.

A postscript to the East Anglia Company's communication was: "We give you our mode of work for clay ground only, not for sandy or peaty ground."*

Singling.—It will be seen from one of the German photographs that singling—best done when the plants have four leaves only—is frequently taken in hand by children. It is undoubtedly the case that pains taken over this operation return a profit. All the authorities insist on the skill required for singling, and on it being well worth while to spend sufficient time over the work to select the likeliest plant and to make sure that it has a good hold of

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* Manurial Treatment of Light Soils.—For light, sandy, or peaty soil (says the East Anglia Company's handbook) the quantity of manure per acre should be slightly increased; the proportion should be roughly as follows:

Superphosphate	10cwt.
Kainit	10 ,,
Nitrate of Soda, First Application	1 ,,
,, ,, Second ,,	1 ,,
,, ,, Third ,,	2 ,,

Basic slag may be used instead of superphosphate.

the ground. Our labourers, except in market gardening districts, are not accustomed to hands and knees work, but it may prove to be a *sine qua non* of the best beet culture.

Cost of Delayed Thinning.—A German experiment in thinning at different dates was made with four neighbouring lots of the same crop of beet. The result per acre was as follows :

THINNED.	YIELD.	LOSS PER ACRE AT 20s. PER TON.
At the right stage	15 tons	—
A week later	13½ ,,	30s.
Two weeks ,,	10 ,,	£5
Three ,, ,,	7 ,,	£8

A writer in the *American Beet Sugar Growers' Annual* says :

> When most of the beets have formed four leaves, thinning should begin. Do not wait for all to reach this stage. The plants should be thinned within a week.*
>
> The thinning must be preceded with spacing with the hoe. This operation should follow immediately upon the cultivation. The beets should be bunched by cutting across the row with an ordinary 5in. hoe, leaving a 2in. bunch of plants. From this bunch the strongest plant should be left and the others pulled out, care being taken to remove the root of every one of the plants, else it will grow later and cause trouble.
>
> The plants should never be left closer than 6in. and in most cases from 7in. to 8in. are preferable. There has been a great fear that the beets would grow too large, but it has been observed that there is far greater danger that the plants will be too small for profitable cultivation with less distance than those named. Excessive distance, however, should be avoided, as there is a tendency for sugar content and purity to decrease under such conditions.
>
> The ground should be pushed well up around the plant by the thinner, but not packed. It is advisable for the thinner to follow

---

* A Norfolk correspondent writes on June 4th, 1911 : "The beets have in 15 days grown from two leaves and two buds to eight full leaves. The weather was very warm."

> close behind the spacer, as the soil is then fresh and the thinning can then be done more expeditiously than after it has dried. Further, the plants are but once disturbed, so the remaining roots recover more rapidly from the shock of thinning.

Another beet expert, quoted in the same publication, advises a 6in. or 7in. hoe, and leaving little bunches about 8in. apart. It appears from this authority that the American farmer has got some of his men—foreigners, no doubt—on their knees in the beet field:

> Immediately following the first operator (we read) comes a man on his hands and knees. His business is to remove all but one beet, making sure that this survival of the fittest is the strongest and best. He performs his task by selecting the favoured plant, gently pressing his fingers down around it, and pulling out all others and throwing them away. He is careful not to uproot the remaining beet, and, in removing the surplus ones, the roots of the chosen plant are carefully guarded. After pressing the earth down gently but firmly, and taking out all weeds in the row, he passes on to the next bunch, still on his knees, in which posture he remains throughout the row. Simply and briefly this constitutes the entire process of bunching and thinning, but in reality so complicated and important is the work that on it hinges the success of the crop.
>
> The fundamental principle of this bunching and thinning operation is painstaking care. Probably in most localties to-day the prevailing practice is that of carelessness, owing to the character of the labour employed.

The Importance of Hoeing.—As the crop grows, care must be taken in hoeing not to damage the leaves, the sugar factories of the plants. There cannot well be too much hoeing. The weight and the sugar percentage are increased by the hoe. Knauer and Hollrung refer to some trials in which from one to five hoeings were given, the times being arranged so that the third hoeing on one plot was given at the same time as the fifth hoeing on another plot. The yields increased with the number of hoeings, as follows:

> One hoeing, 6 tons per acre; two hoeings, 7¼ tons; three hoeings, 9½ tons; four hoeings, 11¼ tons; five hoeings, 11¾ tons.

The American authority on thinning says of hoeing:

> At the time of thinning, the first hoeing should be given in order to loosen the ground, which has become packed from the operation of bunching and thinning, and thus to allow a proper circulation of air, and for the further reason that it is cheaper to do this work at the time indicated. At this hoeing great care should be taken to kill the weeds close to the plants, but in such a manner as not to loosen the plant or injure it. This hoeing should be to the depth of 3in.* A similar hoeing is necessary when the land again becomes foul and weedy† so as to kill the weeds between the plants in the row.
>
> Generally two hand-hoeings are sufficient when the horse cultivation is well done. Each hand-hoeing should exceed the preceding one in depth. Ordinarily no work is needed in the field after eighty or ninety days from the time of planting except the final and deepest horse cultivation. A forced late growth must be studiously avoided, as it is certain to result in a decreased sugar content.

Dr. Diedrich Meyer says:

> Should the soil not be clean, the first hoeing may be done between the drills before the plants appear, or very soon after. This may be done by hand or by horse-hoeing.‡ When three or four leaves are showing, the second hoeing should be done by hand. The thinning out follows. The third hoeing, by hand, must be done before the roots touch. Preferably this is done by advancing at a right angle across the rows. The soil must be well loosened between the plants.

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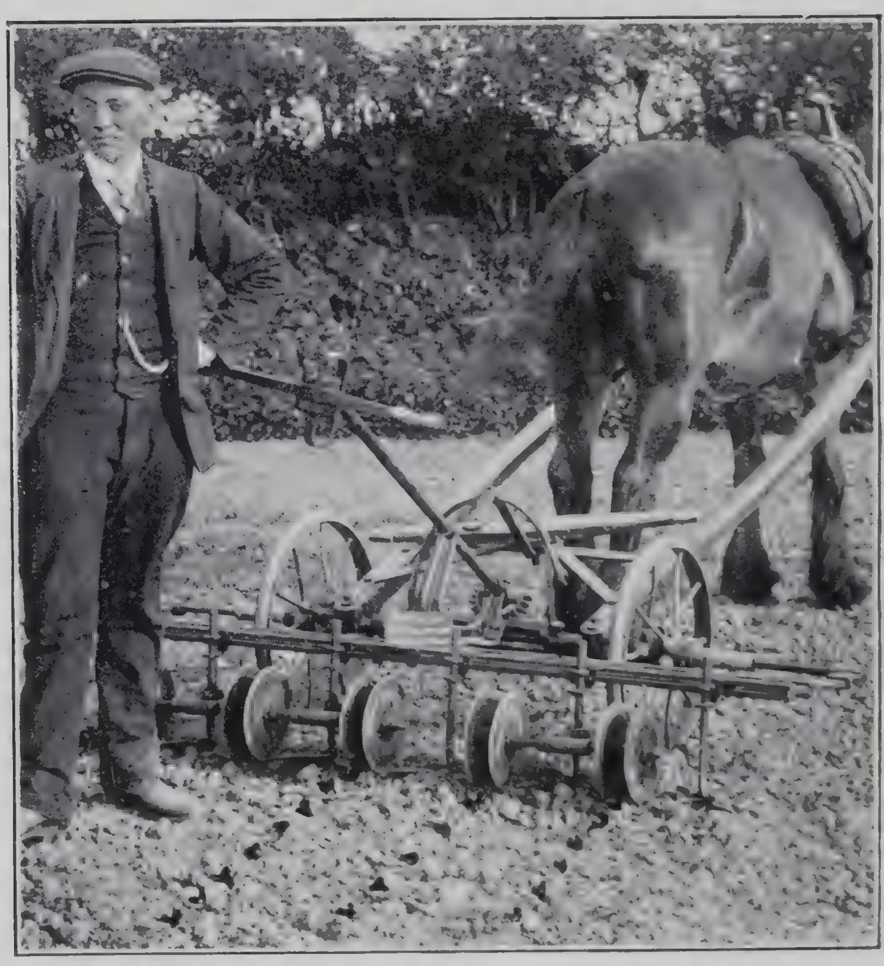
* A correspondent with German experience writes that "3in. is too deep; 1in. to 1½in. is nearer the mark. They would loosen the young plants. Later, when plants have a good hold, go as deep as possible."

† If hoed early, the land never becomes "foul and weedy."

‡ "La Betterave à Sucre" says that in normal conditions a light horse-hoeing should be given "about the tenth or twelfth day," and that "the beet suffers visibly from delaying this operation several days."



THE DUTCH HOE WITH DISCS FIXED TO SAVE THE YOUNG PLANTS FROM BEING SMOTHERED

The black dots indicate where the plants would be

The Latest Advice from Holland.—Mr. Sawyer kindly informs me that the following advice has been given by Mr. Jan Van Agtmaal in Norfolk:

> As soon as the rows are fairly visible, *i.e.*, when about 4 leaves show, which will be in about 21 days, weeding or cleaning can commence, and this can be done by horse-hoe, the horse walking between the rows as much as possible.
>
> A fortnight later, when the plants should be strong enough to bear handling, they can be cut out to about 12½in. by the horse-hoe being driven crossways to the drills, and can then be singled by hand-picking.
>
> The horse-hoe, which is imported, must be kept at work as long as it is possible without injury to the plants.
>
> After that, recourse must be had to hand-hoeing until the leaves cover the ground, which they will do by July.*
>
> After that no more cleaning is needed, even if it were possible.

English farmers will be reassured by the fact that the horse-hoe plays a very large part in this programme. It is some time since a motor-hoe was introduced in France.

Hungarian Practice.—The following notes on Hungarian practice are collected from a series of articles in the *Mark Lane Express* by Mr. W. C. Easdale, who states that he writes on a seven years' experience of beet culture:

> The autumn ploughing is specially important, as it should be carried out to a depth of 8in. to 10in. The deep ploughing was performed for the greater part by steam-ploughs. The second ploughing, harrowing, rolling, &c., is carried out in the same way as for other crops, the special aim being to reduce the soil to the finest possible condition.
>
> In Hungary the seeds were sown in continuous rows 16in. apart.
>
> During the first week of May the first hoeing was performed.†

---

* "Beet," says a French writer, "cannot be hoed too much or too often." The Germans say, "The sugar comes with the strokes of the hoe."

† The date for England would be later. The first hoeing should be done as soon as the green line can be seen.

The thinning of the plants took place in two or three weeks' time, according to their growth. The best results were obtained from beets grown 5in. or 6in. apart.

In order to ensure that the distance between the plants should be uniform the labourers were provided with small sticks of the given length.*

At the time when the thinning was carried out the second hoeing was performed, and special care was given to this work to ensure that the soil all round each plant, as well as in the spaces between the rows, was hoed as deep as possible.

The third hoeing took place in the last two weeks of June, and on this occasion not only were the weeds all cleared away and the soil well hoed, but each root was covered in with earth half way up the stalks of the leaves.†

At the first hoeing a horse-hoe could be successfully applied.‡ The second and third hoeing could be thoroughly performed only by hand.

For example, when hoeing for the second time, directly after the thinning had taken place, very few plants were to be found in an upright position. Many having lost their neighbours, which supported them on both sides, were level with the ground; indeed, one often found plants almost without any connection with the soil. Such plants had to be replaced with the hand in an upright position and forced to remain so with the aid of the hoe, the necessary soil being taken from the space between the rows.§ The thorough covering in of the roots with earth, performed in connection with the third hoeing, was also only possible with hand hoes.

In thinning the plants the spaces between them were regulated according to the character of the soil. If moist, the plants never cease growing until the beginning of autumn, when the sun has already lost much of its power. As long as the root grows, however,

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* "A hoe of the necessary width is better and saves time," a correspondent notes.

† "The great thing is to draw the earth towards the roots and not away from them."—*Ibid.*

‡ *See* note below.

§ "But the young plant should not be so severely hoed at first," writes a Continental correspondent: "if not so treated they will be standing up all right."

> it can store up no sugar. This is partly preventible by leaving smaller spaces between the plants. The roots cannot grow to such a large size, and as soon as the growth ceases sugar begins to accumulate in the sap.

Mr. Easdale has since written that the horse-hoe is no longer used. Hand-hoeing has been adopted, and the beets are grown more closely, and have an increased sugar content from 12 to 14 per cent.

An American Suggestion as to Labour.—When so much depends on careful work among the beets, what can be done to make labour less careless? An American writer has views on a sliding scale of payment:

> Probably the usual plan to-day is to pay for the compound operation of bunching and thinning. This means, of course, that at the same time the beets receive their first hoeing. Now when it comes to paying for pulling, topping, and piling, why not, instead of paying a set sum per acre for this work, allow so much per ton instead of a stated amount per acre? It will obviously be to the labourer's advantage to secure a perfect stand of beets when the highest priced operation of the entire season—topping—is to have its payment based on conditions almost entirely within his control. Many a time have I watched the thinning act, and, with hardly an exception, no effort is made to guard the selected beet by pressure with the fingers, or in any way to preserve its rooting. Full labour contracts for the entire season are usually most satisfactory.

In the latest volume of the Year-book of the United States Department of Agriculture it is stated that the labour difficulty is met in some beet districts by arranging school holidays when the beets are ready for lifting. "In some localities the teachers, both men and women, spend a part of the long vacation in the beet fields, much to their advantage physically as well as financially." In certain localities gangs of labourers take the work of a district, living in movable houses, which are drawn from farm to farm as required. These men are principally Belgians, who work very long hours; "they often utilise every hour of daylight."

An Australian Plan.—The State, which is re-opening a beet sugar factory in Victoria (at Maffra), closed a few years back, is to organise the field labour necessary for thinning and topping the beet.* Mr. Lee, a Government expert, has furnished the Minister of Agriculture with a report. He states that, in order to ascertain in the most practical manner the earning capacity of unskilled labour at thinning beets:

> Two men selected by the Rev. A. R. Edgar and the authorities of the Salvation Army were last season sent up to Maffra to do this work upon the experimental plots. Both these men made voluntary statements to the effect that they could make 6s. per day at beet thinning, on the basis of 27s. 6d. to 30s. per acre. Experienced onion thinners, which crop entails twice the work of beet thinning, by reason of the rows being only 9in. apart, instead of 18in. with beet, have expressed their willingness to take large areas of beet thinning at the above prices. The prospective beet growers have expressed themselves as quite agreeable to pay from 27s. 6d. to 30s. per acre for beet thinning.

Mr. Lee adds, what is certainly true, that the prompt thinning of the beet crops governs the ultimate yield more than anything else. He goes on:

> It is perfectly understandable that few persons will go to the country in search of work of unknown character, and with no guarantee of definite earning capacities. I propose to send each person or family to a given number of acres of beet in a specified district, at a fixed rate per acre. There would be a period within which the work must be completed, and passed by the Government

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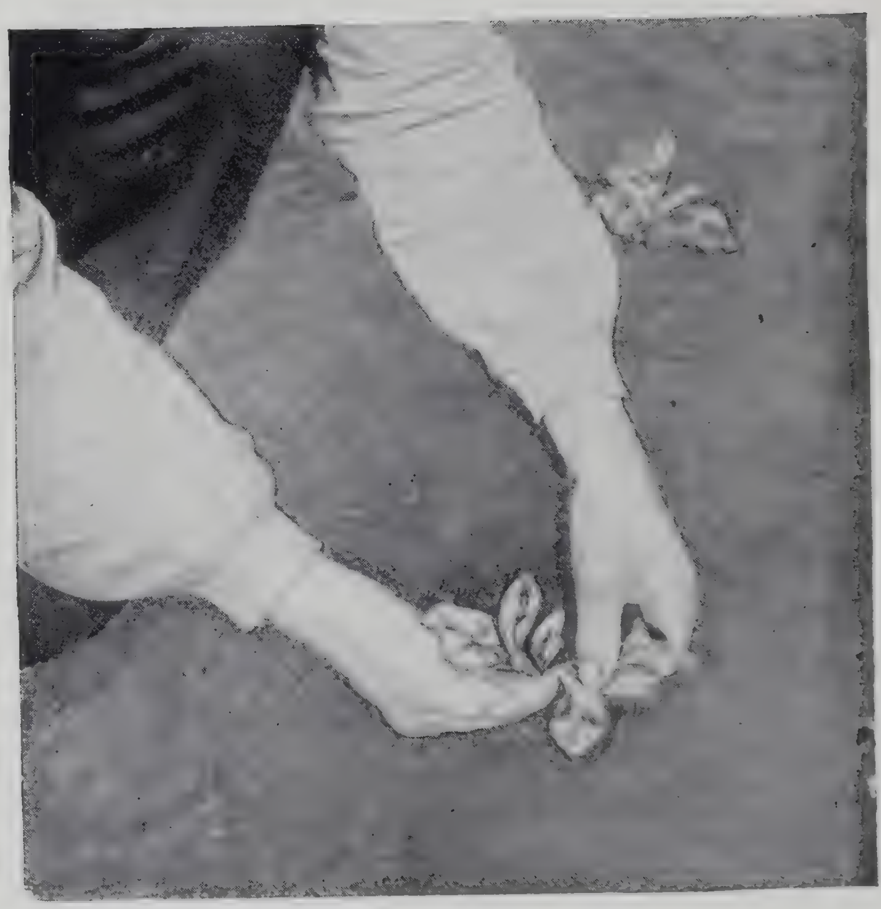
* The crop anticipated is 10 tons an acre.



How the Continental worker makes the young plant firm in the soil

The singling cannot be completely done with the hoe supervising officer and the grower concerned, before payment would be made. The approximate areas required to be thinned by contract would be 800 acres. Allowing five days to thin an acre of beet and a thinning period extending six to seven weeks *(sic)*, it would require about 100 persons to be engaged in the work. If family labour could be arranged for, it would mean that not more than thirty to forty families are necessary. A family of three could earn from 15s. to 18s. per day, with a guarantee of about six weeks' certain labour. When these facts are made known through the proper channel, I have little fear that the response will not be quite satisfactory. In regard to the topping of the beets at harvest time, the same scheme of organised labour can be arranged for. Beet topping in the United States and on the Continent is carried out at a price ranging from 1s. to 1s. 6d. per ton, according to the average size of the roots. Large beets are more easily topped than small ones and weigh heavier.

The Hop-Picking Precedent.—Mr. Dalley, ex-mayor of Kidderminster, who is the moving spirit in the Kidderminster venture, has conceived the idea of arranging with the local Labour Exchange for the organisation of gangs to go to beet growing farms in the same way that this exchange arranged in 1910 for 1000 hop-pickers for hop-growing farmers. The value of this class of labour is discussed in Chapters XIV. and XXIII.

Manure.—In the East Anglia Company's handbook programme, the following advice on manuring was given :

Oct.—Nov. : 6cwt. to 8cwt. super ; ditto kainit.
April—May : ¾cwt. nitrate.
June : at chopping out, ¾cwt. nitrate ; at singling, 1¼cwt. nitrate.

In the typescript instructions the weights were practically the same :

In December, 8cwt. of superphosphate are strewn on the land that has been ploughed, but it may be delayed until January. At the same time as the drilling is done 90lb. of nitrate is strewn on the land, and again 90lb. when the plants have been put in, and 180lb. per acre a fortnight later.

Mr. A. D. Hall, in the *Journal of the Board of Agriculture*, in 1905, wrote as follows on manuring:

In the rotations practised in this country it is difficult to give a coat of farmyard manure to any crop immediately preceding beet, and as the first start of the seed is very much helped by the presence of some easily decomposing organic matter, it will be generally wise to use some dung for this crop, 12 to 16 tons per acre, which, as mentioned above, should be ploughed in before the winter. The other manures required are about 3cwt. per acre of superphosphate and 1cwt. per acre of sulphate of potash, which should be sown broadcast and worked in by the last cultivation and harrowing before sowing. On sandy and gravelly land the sulphate of potash should be increased, since the production of sugar is very dependent on a free supply of potash. If kainit be used instead of the sulphate of potash, it should be sown before the land is ploughed up for the winter. Valuable as salt is for mangels, it should not be used for beet.*

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* SALT.—Mr. A. D. Hall kindly answers an inquiry of mine as follows: "On many soils salt does increase the yield of mangels and sugar beet because it liberates potash in the soil. It is considered, however, that it often results in a lower sugar content; and on heavy soils it acts injuriously on the tilth. I think it would be safest to recommend it on light soils only."

The question of the relation of salt to beet is discussed in a report of the Wohanka Station (1909), and some experiments in the use of salt as a fertiliser are summarised. Wohltmann says beets "readily respond" to it, and have stood even 400lb. per acre. Damseaux says salt does not lower sugar percentage or the purity of the juice. Briem has also found the quality of beet unimpaired by salt, and suggests trials with from 150lb. to 300lb. applied before the final harrowing. On light soils he thinks salt, used as a top dressing, may help by retaining moisture.

Nitrogenous manures are necessary, but should be used in smaller quantities than with mangels; nitrate of soda, again, is not so suitable a manure as sulphate of ammonia, though it produces a larger yield. The nitrate of soda encourages a more deeply rooting habit, and, in consequence, a more prolonged and slowly ripening growth.

If dung has been used in the autumn it will be sufficient to sow 1cwt. per acre of sulphate of ammonia with the superphosphate and sulphate of potash; in the absence of dung a further 1cwt. of sulphate of ammonia should be used as a top-dressing when the plants are singled.

Mr. Koppeschaar recommends dung and potash before ploughing (more on light soils than on heavy*), "superphosphate in excess" (on heavy soils, 5cwt.; on lighter, 5½cwt.) either before or at sowing. He says that the modern beet seems to stand quick-acting, nitrogenous manures better than formerly. The objection to too much nitrogen is that the plants are kept growing until it is too late for them to ripen. Super "may counteract this to some extent." The same authority advises nitrate at sowing, thinning, and when the plants are beginning to cover the ground, "to the extent of 1½cwt. to 4cwt."

Why a Complete Manuring is Necessary.—Though the sugar content of the beet is large—it may be a fifth of its weight—this in itself, the writer in the *Journal of the Board of Agriculture* says, "does not mean the extraction from the soil of any of the fertilising elements; the sugar is formed in the leaves, chiefly at the expense of the carbon dioxide of the air. In order that the beets may grow well and rapidly, however, to supply the rest of the plant constituents, and to enable the accumulation of the sugar to take place in the root, the crop requires a complete manuring with dung and artificial fertilisers."

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* "It is the experimental fields, however, that will have to solve the question whether or not kainit and other potash fertilisers can be profitably applied to any particular soil."—*Ibid.*

This manuring is not lost when the crop is harvested. A large part of the plant food is returned in the leaves and crowns, while the pulp is fed and thus in part converted into meat and milk, and in part returned to the soil as dung. Use is also made of other residual products. When the pulp is fed to stock and the dung is well managed, the manurial losses are small and comparable to those which take place in feeding mangels. If the pulp is not fed the losses are heavy, as when roots are sold off the land.

For the purpose of raising a crop of beets, however, large quantities of nitrogen, phosphoric acid, potash, and lime are required,* and the

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* Beet Ash Analyses.—Analyses of beet ash show, says Newlands, that this crop takes from an acre :

Potash...........	161·92lb.	Phosphoric acid...	40·48lb.
Nitrogen.........	105·60lb.	Lime, &c.	31·68lb.

An analysis of the complete plant quoted by Mr. Koppeschaar is :

Potash...........	224·31b.	Phosphoric acid ...	47·6lb.
Nitrogen	123·7lb.	Lime, &c.	83·25lb.

The leaves contained of this :

Potash...........	89lb.	Phosphoric acid ...	15·6lb.
Nitrogen.........	66·7lb.	Lime, &c.	69lb.

American calculations, for the root only, are for 2000lb. of beet :

	Variation.	Average.
Potash.............................	6 to 8lb.	7lb.
Nitrogen..........................	3 to 5lb.	4lb.
Phosphoric acid..................	1 to 3lb.	2lb.
Lime	1 to 1½lb.	1¼lb.
Magnesia	1 to 1½lb.	1¼lb.

An American writer adds : " These weights do not fix, absolutely, the amount of plant food needed by beets, but they suggest something as to the relative quantity of ingredients withdrawn by the crop. It is true that all beet soils contain far more nutritive matter than percentage of the chief ingredients appears to vary with the sugar content, beets rich in sugar taking comparatively less from the soil than those which are poor in sugar.

According to Garola, lime and nitrogen are the ingredients most favourable to the crop during the first two months after the sowing of the seed, after which phosphoric acid and potash are increasingly required, though lime is the dominant ingredient to the end of growth. The practical conclusion derived from a consideration of the movements of absorption seems to be that the beet needs moderate manuring with dung, fortified with superphosphate, nitrate of soda (or sulphate of ammonia), and a potash manure.

Quantities of Manure.—The quantities of manures recommended are:

From 8 tons to 12 tons and not more than 16 tons per acre of dung, according to the soil and conditions of cropping; with 2½cwt. to 4½cwt. of superphosphate, 1½cwt. to 2cwt. nitrate of soda, and 1½cwt. sulphate of potash or 6cwt. of kainit. Artificials are usually distributed broadcast, and, with the exception of nitrate of soda, may be ploughed in or drilled. In experiments conducted in Germany between 1890 and 1899 on over 1700 acres, Kiehl found that nitrate of soda gave the best results as a top-dressing applied in three lots, viz., when the seedlings first appear, and after the first and second hoeings. It may,

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these figures prescribe, but these materials invested as soil capital are not modified so quickly that they are always available in the form of easily soluble food for the growing beets within 150 to 170 days of vegetation. This is why we add supplementary fertilisers."

The following "amounts of fertility removed from an acre" appears in an American publication: "Sugar Beet and Beet Sugar" (*Beet Sugar Gazette* Co., 1911):

KIND OF CROP.	YIELD.	NITROGEN.	PHOSP. ACID.	POTASH.
Sugar beet......	10 tons	30lb.	14lb.	70lb.
Wheat	20 bus.	41lb.	13lb.	17lb.
Oats	40 bus.	40lb.	14lb.	33lb.
Barley	30 bus.	56lb.	17lb.	51lb.
Clover hay......	2 tons	82lb.	18lb.	88lb.

See also Appendix, "Beet *versus* Mangel."

however, be applied at two operations, half before sowing and half after singling. On sandy and moorland soils basic slag may be used. being distributed in the autumn previous to sowing the seed.

In general, manuring may be on the basis of manuring mangels, but it should be remembered that only about half the weight of roots can be grown, and that large quantities of forcing manures like rotted dung or nitrate of soda may injure the quality.* For medium loams in the South of England the following manuring would probably be found to be satisfactory :—10 tons to 12 tons of dung ploughed in after harvest, with 1cwt. sulphate of ammonia, 4cwt. of superphosphate, and ¾cwt. sulphate of potash applied before sowing, and ½cwt. nitrate of soda applied as a top-dressing after singling. It is, however, advisable that trials with various quantities of manures should be made on every farm and each type of land when the first crop is grown, so that information suitable to local conditions may be obtained.

Advice from Bohemia.—Mr. Schobloch kindly sends me the following notes condensed from the data of Dr. Diedrich Meyer† :

Sugar beet is a typical potash plant. Next in importance to it, after potash, are nitrates. After these, superphosphates. Heavy crops of beet, 18 tons of roots and 14 tons of leaves per the acre, take away : potash, 200lb. ; nitrogen (elementary), 160lb. ; phosphoric acid 60lb.

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* Analyses have repeatedly shown the disastrous reduction of the factory value of the beet by heavy manuring in the spring. Two monster beets so produced contained only 2·22 and 4·82 per cent. of sugar respectively. A Wohanka bulletin says that at the time beets reach maturity the available amounts of potash and phosphoric acid in the soil should be the dominating plant foods, while the nitrogen supply should be decreasing. With plenty of available potash and phosphoric acid present, beets will be higher in sugar percentage the lower the available nitrogen. Externally, excess of nitrogen is shown by the dark green colour of the leaves and their disproportionately large size.

† Beet is well grown in Bohemia.

Sugar Beet Before and After the Extraction of Sugar

1. Beet sliced ready to be treated by diffusion for the extraction of its sugar. 2. Beet slices after the extraction of the sugar and much of the water, and largely disposed of to farmers like brewers' grains for immediate consumption by stock 3. Dried beet slices, *i.e.*, wet slices put through a special kiln.

Maximum crops are obtained only if dung is given (Professor Schneidewind). The maximum crop grown with artificial only was raised 3 tons per acre by the application of dung in addition to artificial. The total increase in sugar was 7cwt. Dung may be freely given if high-quality seed is used.

Green crops ploughed in are much to be recommended. The value of a preceding green crop has been calculated at £1 an acre. At Lauchstädt, Prussia, a mixture of peas, beans, and vetch is used.

Every beet grower should have, by way of experiment, a plot without nitrates. It is said that plots given 2cwt. of nitrates in addition to dung produce 2½ tons more roots than plots without nitrates. With 15 tons of dung it is not profitable to use more than 2cwt. of nitrate. After green crops (ploughed under), 2½cwt. should be given.

If artificials only are given, up to 4½cwt. of nitrate may be used. It is advisable, especially on clay, to give part of the nitrogen as sulphate of ammonia, if the quantity used is over 3cwt.

On heavy clay, manured with dung, give nearly all the nitrates in the form of ammonia.

On soils rich in lime, mix sulphate of ammonia with superphosphate (16 per cent. phosphoric acid) and bury it well.

Sulphate of ammonia, but not a large quantity of nitrate, may be given shortly before drilling. The last lot of nitrates must be given at the latest by June 15.

Nitrates are preferably given in two or, better still, in three lots.

With dung, 28lb. of phosphoric acid to the acre is ample. Without dung and after green crops, 48lb. to 67lb. should be given. The usual superphosphate of commerce contains 16 to 18 per cent. of phosphoric acid. Slag should be used on light soil only, because on heavy land it decomposes too slowly.

Dung contains about 0·7 per cent. of potash, so 15 tons to the acre mean about 224lb. of potash. On good land, especially that which is rich in lime, artificial potash manuring does not pay if 15 tons of good dung are given.

Kainit should be given after green crops, if no dung is given, and always on light land. It should be used in preference to 40 per cent. potash salt, because beets are fond of salt. The superfluous mineral substances are chiefly left in the leaves, so the quality does not suffer much. If much potash is given, however, first-class seed is required. In roots of inferior seed the sugar percentage has been shown to decrease by 1·40 per cent. when much potash was given. With superior-bred roots the total sugar content was increased. If potash must be given, the 40 per cent. salt must be used within three weeks before drilling.

After green crops or minerals only, 7cwt. to 8cwt. kainit or 2cwt. 40 per cent. potash salt. If 8 tons of dung are given, 4cwt. to 5cwt. kainit or 1½cwt. 40 per cent. potash salt. In a very dry season large quantities of potash may be injurious.

On soils poor in lime, 4cwt. of lime should be given, ploughed in the autumn four or five inches deep.

On heavy clay land, dung turned in just below the surface with two-share ploughs in the autumn—the deep ploughing being done later—has been found very beneficial.

Norfolk Practice in 1911.—The manuring instructions issued on behalf of Mr. Ali Cohen are to the following effect, Mr. Sawyer tells me:

The land, if heavy or light clay, should be manured with any amount of dung up to 30 tons per acre, which should be ploughed in during October, November, or December, to 12in. or 13in. in heavy and lighter clay soils. In the case of the lighter or more sandy soils, the manuring may be left till the spring and then be carted out and ploughed in about a fortnight before sowing the seed.

The following manures have been used: (1) 3cwt. per acre of a compound manure guaranteed 7 per cent. ammonia, and 9 per cent. potash. (2) 4cwt. per acre of a compound manure guaranteed 35 per cent. phosphates, 2·5 ammonia from sulphate of ammonia, and 2·5 pure potash. (3) 3cwt. per acre super, 1 cwt. sulphate of ammonia, 20 per cent. N., and 1cwt. sulphate of potash 48 per cent. potash.

Artificial is to be sown broadcast and then harrowed in and rolled down before drilling, but the land must be clean. After drilling, harrow lightly, and roll down.

After the first hoeing it is well to sow broadcast 1cwt. of nitrate of soda 15 per cent. N. A second dressing of the same quantity is given after singling.*

The Sugar Beet and Soil Fertility.—Sugar consists of carbon, hydrogen, and oxygen. As Dr. Jodidi says, in "Sugar Beet and Beet Sugar":

> Nature furnishes them in abundance in the shape of carbon dioxide and water. But in addition to the sucrose† there are some other elements which are contained in the beet, namely, potassium, phosphorus, nitrogen, lime, magnesia, &c. Hence in the sugar juices the so-called mineral non-sugars. And it is just these non-sugars that exhaust the soil, making at the same time a poorer grade of beets both in sugar percentage and purity. Such non-sugars, exhausting as they do the soil, must be returned to it by the use of manures and fertilisers.

It is then evident that if it were possible to raise an ideal beet consisting of pure sugar juice, *i.e.*, of sugar and water only, the soil would not be exhausted at all; no fertilisers would be needed after a beet crop. While this is an impossibility, as some nitrogen, phosphorus, and potassium are absolutely necessary for the formation of the protoplasm of seed and of the sucrose itself, the tendency is to reduce the amount of non-sugars in the beet to the very minimum.

The Moral of the Non-Sugars.—The history of the sugar beet shows, Dr. Jodidi goes on, that with increased knowledge and experience in beet growing the non-sugar contents of the beets were gradually diminished. In about two decades (1870 to 1894) the ash content was diminished from 3·86 per cent. to 2·73 per cent., calculated on the dry substance of the beets, or 29 per cent. of the total ash content.

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* Danish Practice.—Mr. Rider Haggard noted the following as the dressings used by a successful Danish beet grower: 12 tons muck, 3cwt. super, 2cwt. nitrate.

† Sucrose: the sugar in beet, cane, and other plants.

The conclusions to be drawn are instructive. The object of sugar beet raising is in the first place the sugar. This should be kept in mind by the farmer. Everything that leads to the increase of sucrose in the beet is advantageous not only for the sugar manufacturer but for the farmer as well. A beet grower who raises the best, purest beets exhausts *least* his soil; a farmer raising poor beets exhausts *most* his soil. Here the interests of sugar factory and beet grower are identical.

This is also true in a large measure with regard to the tonnage. Generally speaking, medium sized beets, of, say, from 1lb. or 2lb., usually give the best tonnage. Such beets have as a rule also higher sugar content and purity than large sized beets.

When the Crop is Ready.—The instructions given in the East Anglia Company's handbook may be reproduced in full :

The crop is raised between September 15 and October 15, according to the season and time when the fields are drilled. Under ordinary conditions the beets are ripe when the leaves begin to turn yellow, but it sometimes happens that in very dry weather the leaves will turn yellow earlier. If after such a dry period wet weather sets in, the aspect of the fields will again change to green because new leaves are forming. This unfortunately affects the quantity of the sugar being formed in the beet. It must be noticed that, under ordinary conditions, the change from green to yellow in the beets means that the beet has stopped growing but continues to make sugar, and the crop must be raised shortly after the change in the colour.

As soon as the beets are taken out of the ground the tops should be cut off with a knife, applied at the place where the first leaves have grown.

The beets are piled up in small heaps on the fields, covered with the tops to keep them as dry as possible and protect them in case of an early frost.

When the fields are ready, the beets are carted to the factory, the tops remaining on the fields. These tops may be used by the farmer as fodder for the cattle.

When pulling out the beets to cart them away they should not be damaged or bruised in any way, and care should be taken not to damage the thin end.

The following additional notes are extracted from the advice given in the *Journal of the Board of Agriculture:*

Sugar beets must be harvested when "ripe," that is, when they cease growing, contain the highest percentage of sugar, and are most pure. Such conditions may generally be decided by the appearance of the crop, the leaves becoming yellowish-green in colour and drooping more or less, some even falling flat on the ground. About three-fourths of the foliage should have wilted, but the central leaves should still be fresh and green. The decision, however, should be made with care, since the appearance described may to some extent follow prolonged drought, the crop again growing and increasing its sugar content after good rains.

The needs of the sugar factories must also be considered, and the earliest crops frequently realise in France 1s. to 2s. per ton more than the later ones. Not only is it necessary to harvest before frosts occur,* but in time for the sowing of the wheat crop to be put in hand. In order to meet the various requirements it is found useful to sow different varieties of sugar beet possessing unequal powers of growth and ripening.

The careful grower keeps testing his roots. A rough test is "whether the roots, on being cut in two, quickly turn first red, then brownish, and finally quite dark." This is the mark of immature roots, Newlands says. Ripe roots "remain some time unaltered or turn only slightly reddish."

The Place to Top.—It has been generally assumed that beets should be topped at the ground line at the time of harvesting. A series of tests was made by the Bureau of Chemistry of the United States Department of Agriculture. Three lots of six beets each were selected, of four different strains, the first two of normal shape, the last with extra large heads. In the case of the first two lots it was shown that the tops contained as large a percentage of sugar as the rest of the beets, taken as a whole, while the third set showed a much lower percentage, owing to the presence of a hollow core near the top. The inference was that *normally grown beets should be topped at the lowest green leaf stalk; but beets showing unusually large tops should be cut off well down to the ground.* In connection with this matter the diagram on another page is interesting. The object of removing the top with the leaves is, as an American writer says:

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* COVERING THE BEETS.—In any case it is held to be best to cover the roots with their leaves to keep them from the sunlight, but not so thickly as to prevent their soil drying and so falling off when they are moved.

> To prevent the mineral salts which have accumulated in considerable quantity from entering the factory. These mineral salts exercise a very bad influence upon the crystallisation of the sugar and therefore must be removed, so far as possible, in the field. It is further true that by their removal there is returned to the soil a very large proportion of the mineral ingredients which the beet has taken from the soil, and thus its fertility is the better conserved.
>
> The effect of shallow ploughing becomes very evident at the time of harvest in the loss of weight resulting from the required heavy topping of beets that have been forced out of the ground by reaching a hard under soil, which the root is unable to penetrate. Under such conditions the root lifts itself above ground and it becomes necessary to top heavily.

CHAPTER XIII

THE COST OF THE CROP PER ACRE

Experimental Figures.—The cost per acre of growing beet has been very variously estimated.

The late John Algernon Clarke, Mr. Martineau tells me, put it at less than £9 per acre; but that was many years ago.

In 1905, at Great Yeldham, Essex, the following figures were returned, the crops reported upon being estimated at "between 15 and 25 tons":

	£	s.	d.
Steam cultivated in autumn		16	0
Sized on ridge		4	0
Farmyard manure, 20 loads	3	10	0
Labour on same	1	0	9
Four furrowed		8	0
Harrowing twice		1	4
Drilling seed		1	0
Labour, sowing manure		1	0
Rolling			6
Hoeing, 4 times at 5s.	1	0	0
Horse-hoeing, 3 times		4	6
Raising and clamping	2	10	0
Artificial manure	1	6	0
	£11	3	1

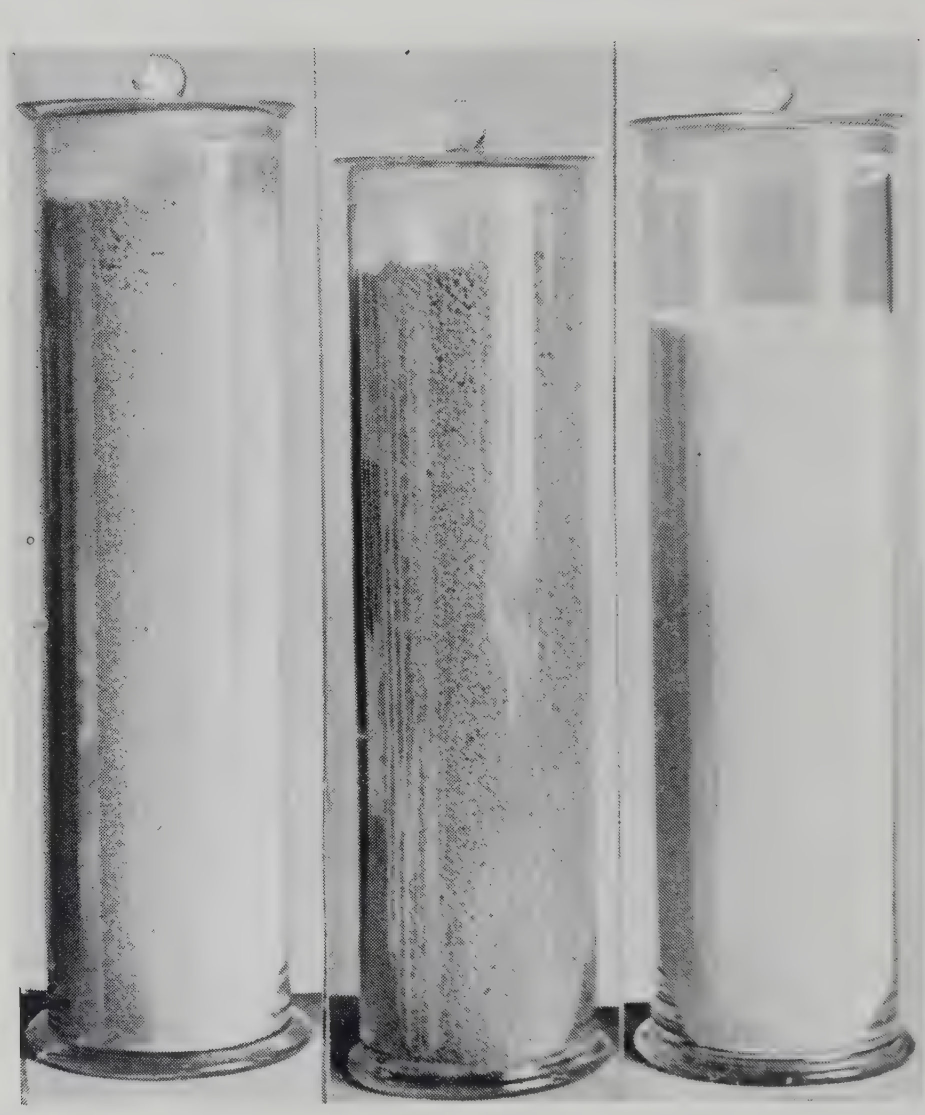
In this case, seed, rent, and rates are not charged.

The costs at three other Essex centres the same year were (including, for the purposes of the average, Great Yeldham):

	£	s.	d.
Maplestead	9	3	0
Great Yeldham	11	3	1
St. Osyth	11	4	10
Great Stambridge	11	17	6
Chelmsford	13	8	0
Average	£11	7	3

The total expenditures in connection with two experiments in Suffolk the next year were returned as £8 4s. 8d. (14 tons crop) and £10 7s. 6d. (18 tons crop). The same year Mr. E. F. Cheney, now one of the Small Holdings Commissioners, grew an acre of beet and reported that the cost was as follows:

	£	s.	d.
Twice ploughing	1	6	8
Autumn harrowing (1 man, 3 horses, ½ day)		6	5
Twice harrowing (1 man, 2 horses, ¼ day)		2	4
Rib rolling (1 man, 2 horses, ¼ day)		2	4
Drilling (2 men, 2 horses, ⅛ day)		1	6
Seed		10	8
Rolling (1 man, 1 horse, ⅛ day)			9
Twice horse-hoeing		3	0
Three times hand-hoeing		15	0
Singling		4	0
Raising roots, trimming, and washing		19	0
Topping and filling		9	0
Carting roots		10	0
Rent and rates	1	2	6
Artificial manure, 3cwt., superphosphate		11	3
1¾cwt. nitrate of soda	1	1	0
	£8	5	5



BEET SUGAR.

1. Unrefined sugar of the quality known as first product. 2. Unrefined sugar of the quality known as second product. 3. Refined sugar.

Here, it will seen, no farmyard manure was used.

Mr. Cheney writes to me: "The 10s. for carting related to carting to clamp, and did not include carting any considerable distance, such as to a railway station." All the figures for these experimental crops I have as yet recorded are, of course, for crops clamped in the field in which they are grown, not for roots delivered to the station, as in the case of commercial growing.

In the following estimate by Mr. Stein (*Journal of the Society of Arts*, December 8, 1905), a price for carting to a factory is given:

	£	s.	d.
Rent and taxes	1	0	0
Clearing and forking weed stubble		1	0
Ten loads farmyard manure	1	5	6
Carting ten loads fresh manure		5	6
Spreading manure		1	0
Ploughing 8in. to 10in. deep		8	0
Cultivating, including harrowing and rolling		6	0
Artificial manure	1	10	0
Sowing		2	6
Seed (20lb. at 4d.)		6	8
Drilling		1	0
Hoeing and thinning		10	0
Harvesting crop		10	0
Carting to factory 15 tons,* three miles, at 6d. per mile and ton, and 3d. per ton labour	1	6	3
	£7	15	5

An English agriculturist, who has studied beet growing abroad, says some of the work could not be done in

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* "I took, as a minimum crop, 15 tons per acre."—Mr. Stein.

Germany at the sums mentioned, and adds: "It was this balance sheet which awakened my interest in the sugar beet question, as, from knowledge of the cost of farming operations in this country, I thought farmers were being misled."

In framing his balance sheet Mr. Stein for some reason added another £1 10s. for "Extra carting to the factory for 15 tons roots," making a total expenditure of £8 15s. 5d. He described his balance sheet as a "new and revised" one. "I am prepared," he said, "to maintain its accuracy." He now appears, however, to be represented by another statement of cost, as follows:

	£	s.	d.
Rent and taxes	2	0	0
Clearing and forking weed stubble		1	0
Ten loads farmyard manure, carting and spreading	1	17	0
Ploughing, 9in. to 11in. deep	1	0	0
Cultivating, harrowing, rolling		6	6
Artificial manure	1	10	0
Sowing		2	6
Seed, 30lb.		12	0
Drilling		1	0
Hoeing and thinning		10	6
Harvesting crop		12	9
Carting to factory	1	6	3
	£9	19	6

Some of the items here are plainly low.

Mr. Stein in recent speeches has given the round sum of £10 as the probable cost. So has Lord Denbeigh.

The average of this £10 and of the Eastern Counties experimental crops, plus 20s. each in their case for carting, works out at £10 18s. 11d. per acre.

Commercial Crops.—We may now deal with the data available as to the cost of growing beet in commercial conditions in the Eastern Counties, based on actual experience in 1910. A report before me by a skilful farmer in Essex, in respect of an 11½ tons crop in 1910, is:

	£	s.	d.
Cultivation and sowing	1	0	0
Hoeing and singling	1	0	0
Manure	2	0	0
Rent, rates, and taxes	1	10	0
Raising	2	5	0
Cartage to station		15	0
	£8	10	0

In ordinary circumstances, however, he reckoned the cost would be £10. He certainly spent a great deal more than £8 10s. on his beet elsewhere than in the field of which he had the exact figures. Cartage is also low.

Another Essex farmer says six acres of his cost £9 13s. per acre, not counting his trouble, which was great. We may perhaps fairly put his estimate of expenditure also at at least £10. His farm is close to the station.

Mr. J. M. Welch, of Dunmow, who is a valuer as well as a farmer, favours me with the following statement of the cost per acre in growing 3½ acres of beet "in rows 28in. apart, to allow for hoeing." This is, of course, an impossible distance. But the details of expenditure are interesting. The crop was grown on land which was "a fair sample of the Essex clay soil and might be described as heavy":

	£	s.	d.
Twelve loads dung, and labour on same	2	8	0
Ploughing		10	0
Scarifying		4	0
6cwt. superphosphate 3cwt. nitrate of soda	2	5	0
Sowing same		2	6
Drilling and rolling		2	6
Seed found free		—	—
Horse-hoeing		6	0
Hand-hoeing, singling, &c.		17	6
Taking up, cleaning, and cutting off tops	2	0	0
Putting on rail		17	6
Rent and rates	1	5	0
	£10	18	0

Mr. Welch writes: "My land was not ploughed deep enough." The crop was 7 tons an acre, washed weight. No doubt the 28in. had a good deal to do with the unsatisfactory return.

Another experienced agriculturist in Essex writes to me that while he is sure beet is not an economical crop on the heavy wheat land of his county, on light loam, of which there is a good deal not far from Maldon, the cost of the crop per acre would be as follows:

	£	s.	d.		£	s.	d.
Steam plough	0	15	0	Raising (when understood)	1	10	0
Drilling and harrowing	0	5	0	Cartage to station	1	10	0
Manure	3	0	0				
Hoeing	1	0	0				
Rent, rates, and taxes	1	10	0		9	10	0

Cartage he reckons at 2s. a ton for a mile, "for the roots to be handled are small, and there is labour at both ends of the journey"; or 8d. to 9d. per ton per mile for cartage, exclusive of labour. This is with horses; by traction engine the cost would be 6d. per mile. This correspondent is estimating 15 tons to the acre.

Mr. Petitpierre (see Chapter XVII.) gives the average expenses of five farmers at £9 18s. 9d., but I have been unable to obtain the details of these estimates.

The Hon. Edward Strutt, who was naturally greatly interested in the Essex experiment, has been good enough to send me the following data in regard to a crop of his of 12 acres:

> Cultivations, the manures, hand labour, and horse labour up to the time of taking the beet up amounted to £7 5s. 6d. per acre. This is exclusive of rent and seed. If you add rent, to include rates and taxes, you could not put it at less than 25s. per acre, as the field was a good one. This would bring up the expenses to £8 10s. 6d.
>
> The cost of pulling, topping, and putting in small heaps comes to £2 per acre including horse labour, but exclusive of any special supervision which might be necessary.
>
> Filling, carting, and delivering on the railway trucks, and filling these trucks, including the time of the horses, amounted to 30s. per acre (the horses being charged at 4s. per day at a busy time of the year).
>
> We delivered roughly 15 tons per acre at the station, and we were to receive 17s. per ton. The actual cheque we have received is a little under £60 per 12 acres of beet, say £5 per acre, the cost having been at least £12.
>
> I think we could take them up cheaper another time, and probably deliver them at the station for rather less money when we understand the best way of dealing with them. Very possibly £1 per acre could be saved if the thing were well regulated and well organised, and the people were accustomed to the work. I think, though, that 25s. per acre is rather a low figure for rent, as you cannot use your out-of-the-way fields, and the land must be of a mixed nature and not too heavy.
>
> The field of 12 acres we are dealing with is about one mile from the station.

No doubt we carted away a fair amount of dirt, and I should not have been disappointed had I been told there was 15 per cent., or possibly 20 per cent., but to have over 40 per cent!

Shall we say, then, that Mr. Strutt would estimate the cost in the future at about £11 5s.?

A Norfolk experimenter also returns his outlay at £12 an acre. It is doubtful, he says, if any considerable area of beet was grown in the adverse conditions and with the other drawbacks existing in 1910 at less than £11, exclusive of seed. Shall we strike a rough average here and say £11 10s.?

Mr. R. Owen Goddard, writing from the estate office of Lord Hastings, stated that "a very careful" account had been kept of the expenditure on the cultivation and lifting of the beet grown on an experimental half-acre, and the following were the figures:

	£	s.	d.
Ploughing three times at the rate of 10s. 6d. per acre—two horses and one man	0	15	9
Dragging twice at the rate of 1s. 4d. per acre—two horses and one man	0	1	4
Rolling twice at the rate of 10d. per acre—one horse and one man	0	0	10
Harrowing three times at the rate of 1s. per acre—two horses and one man	0	1	6
Drilling twice (our drill, being incapable of showing 12in. work, had to cover the ground a second time, 24in. work) at the rate of 1s. 2d. per acre	0	1	2
Muck, five loads at 4s. and preparing, carting, and spreading same 6s.	1	6	0
Hoeing and cutting out, June 8 to August 18	1	10	6
Raising, topping and delivering to station—manual labour £1 9s. 7d., horse labour 18s. ...	2	7	7
Rent, say £1 per acre, rates 3s. per acre...........	0	11	6
	£6	16	2

Gross weight as delivered at station	6 tons 3 cwt.
Less deducted for mould on roots	10 cwt.
Net weight paid for	5 tons 13 cwt.
At 17s. per ton free on rail	£4 16s. 3d.

Charging an acre at the same rate as this half an acre, Mr. Goddard's expenditure for an acre would come to £13 12s. 4d.* This is obviously a high figure in view of the fact that no artificial was used and only a small amount of dung was spread.

Mr. A. Cossey, who also grew half an acre of beet "under the same disadvantages as Mr. Goddard, upon land without farmyard manure or any special preparation" reports :

> Weight of beet 7 tons 10cwt. gross, for which I received a cheque for £5 17s. 6d. My expenses did not exceed £5. The expenses as detailed by Mr. Goddard are such as would be incurred if team and other labour had to be specially engaged, instead of being done by the usual farm supply.

Suppose we average Mr. Goddard's £13 12s. 4d., and Mr. Cossey's £10, at £11 16s. 2d.? (Mr. Cossey sent as an illustration of charging to a root crop its whole cost, the details of an acre of mangel. They showed that it cost £8 6s. 5d., and "as when consumed on the farm it very rarely comes to £6 an acre," the loss was £2 6s. 5d.)

English Average.—The sums which the farmers who have had experience of growing sugar beet in East Anglia

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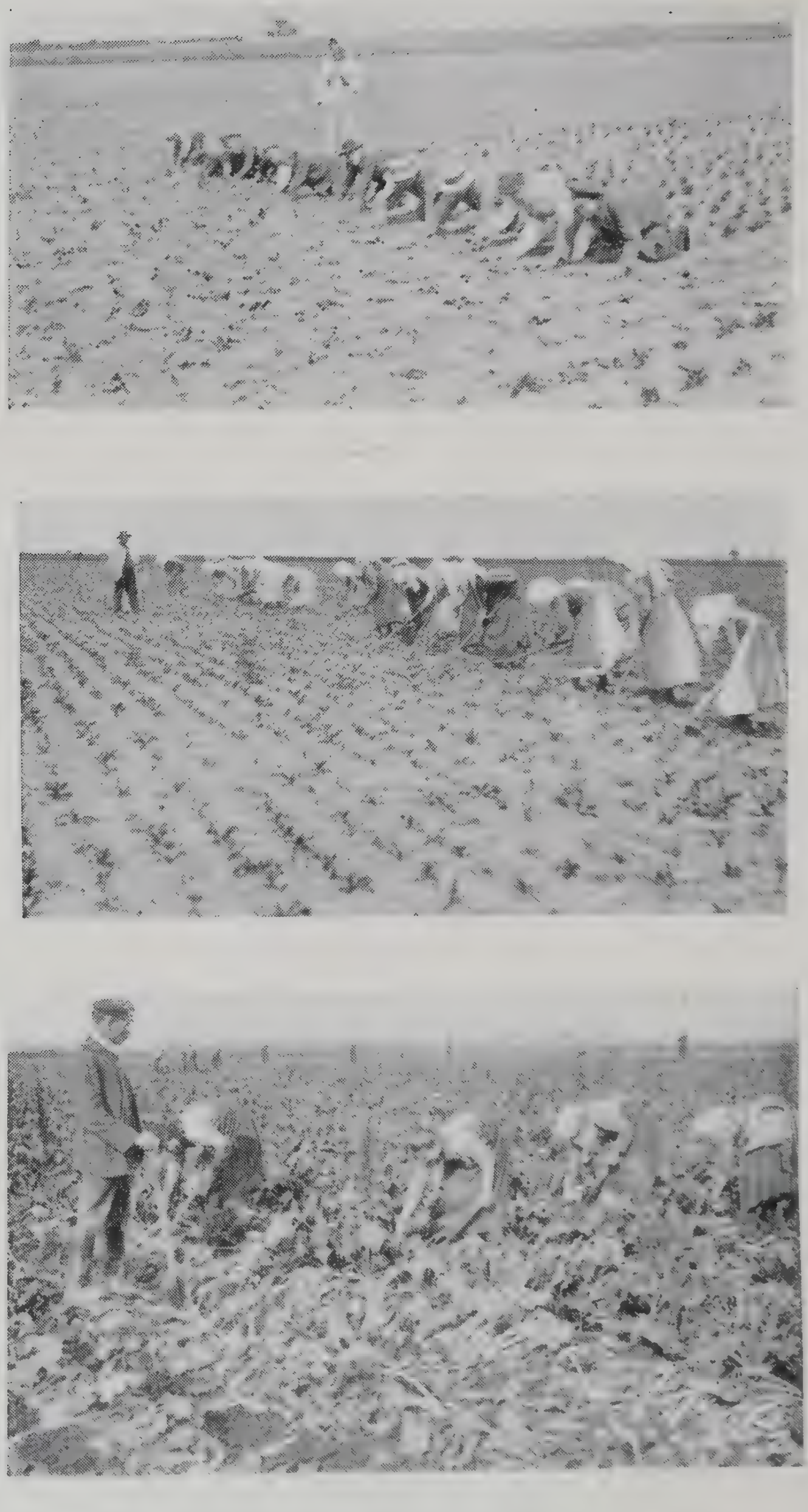
* Commenting on this Mr. Cohen wrote : "I find on reference to my expert's report on the experiment on the estate of Lord Hastings the following remarks : 'Soil magnificent. Plot very badly selected. Should have been selected in the middle of the field, and not on the oblong piece of land for about a third covered by the shade of the large trees and hedge, preventing the entering of sunshine. If selected in the middle of the field should produce extremely rich crop. Seems over-manured [*sic*]. Singling and weeding must be improved. Rabbits in the fields.' "



SCENES IN THE BEET FIELDS NEAR MAGDEBURG
Children singling—Women hoeing—Women lifting the beets with the short-handled forks. Note the gangers.

Germany.—According to Geschwind the cost of growing an acre in 1900 amounted to:

	£	s.	d.
Rent, taxes, &c.	1	12	5
Various cultivation	1	12	5
Manuring	4	1	0
Seed 2s. 6d., sowing 12s. 2d.		14	8
Hoeings, singling, &c.	1	10	9
Carting		19	5
Interest, sinking fund, &c.	1	1	3
Total	£11	11	11

In the neighbourhood of Halle the cost has been put at:

	£	s.	d.
Autumn cultivation		19	1
Spring cultivations		19	1
Seed		11	4
Sowing		4	0
Singling		3	3
Two hand-hoeings		7	11
Four horse-hoeings		3	2
Lifting and storing*		19	1
Carting, transport, &c.	1	14	3
Rent, taxes, &c.	2	17	1
Manures	5	3	6
	£14	1	9

In other cases in Germany the cost has been estimated as:

	£	s.	d.
Near Breslau	9	17	4
West Prussia	12	10	0
Hanover	10	18	0
Brunswick	14	5	6

---

* Putting into clamps, or in heaps, if for a short time only, and covering with 9in. of earth.

Against this £14 5s. 6d. should be set the cost given by a correspondent in Brunswick, £8 5s., and £1 5s. rent and taxes; but this is on easy-working land. Prof. Dr. P. Holdefleiss, of Halle, Prussia, estimates the cost of producing and marketing an acre of beet at £13 12s.

Mr. A. O. T. Bennett states that he has received the following particulars as to cost of labour, field work, &c., from a farmer who has been growing beet for the last thirty years in Westphalia:*

	PER ACRE.		
	£	s.	d.
Cost of deep ploughing either with steam plough or 4-5 oxen in autumn, 11s. to 16s. 6d., according to how land works, average		13	9
Cost of seed 20-25lb. at 4d., average		7	6
Cost of artificial manures	2	15	0

The cost of cultivation varies considerably, it depends on how the land works, if wet or dry, or if there are many weeds, &c.; the normal process for preparing the land for seed is:

Grubber, 3-4 horses.
Heavy wood roll, 3 horses.
Grubber, 3-4 horses.
Heavy wood roll, 3 horses.
Heavy harrows, 2-3 horses.
Cambridge roll, 2-3 horses.
Medium harrows, 2 horses.
Light roll, 1-2 horses.
Drill, 3 horses.
Seed harrows, 1-2 horses.
Light roll, 1-2 horses.

	£	s.	d.
These operations would cost about	1	5	0

(More or less, according to the condition of the

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* GERMAN FIGURES.—Mr. Bennett is good enough to write to me: "My figures are an average, not the best and not the worst, also my rates for labour are low; but this is also regulated to a certain extent by the yield [given at 10½ tons]. The provinces I quote from are Westphalia and Hanover, not the best beet growing country, but I think they are fair average places. My friend sends to one of the largest factories in Germany. Four Saxon gentlemen I have been travelling with say my figures would be about the average."

	Per Acre.		
	£	s.	d.
soil. It must, however, be nearly as fine as garden land, or the tender young plants will not come through satisfactorily.)			
The cost after sowing involves on an average :			
First hand-hoeing		2	9
Second hand-hoeing		3	5
Third hand-hoeing		4	2
Separating with hand-hoe, leaving about six young plants standing between each stoke of hoe		1	9
Singling young plants *by hand*, leaving only one standing (done by children)		3	5
Two or three times going through roots with horse-hoe, at 1s. 4d. each time, average		3	4
To harvest roots in heaps of one cartload, and to cover with leaves for immediate carting to factory, costs from 12s. 6d. to 16s. 6d., according to how roots lift, average		14	6
Carting to factory or station, 20s. to 26s., average	1	3	0
Cost of cultivation per acre	7	17	7

To this sum must be added the cost of rent and rates, as well as charges, if roots have to be sent by rail. If we add for rent and rates the average of the Halle estimate, £2 17s. 1d., and Geschwind's, £1 12s. 5d., they would come to £2 4s. 9d. Mr. Bennett kindly informs me, however, that this farmer would not have to pay more than 25s. for rent as his land is not of the best kind for beets.*

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* As other estimates of the cost of growing beet show, all German rents are not so low. Mr. Champion, one of the Maidstone delegates, writes to me with regard to the farmers near Magdeburg: "They are paying 50s. to 60s. an acre for stiff clay land that we could only lay down to grass."

If we knock off the 4s. 9d. we bring his total expenditure to £9 17s. 7d., or practically the Breslau figure.

A correspondent on the North-western side of the Harz mountains returns his expenditure at £8 5s., but rent and taxes and carriage to factory are not included. His land is not particularly good. He gets a crop of from 9½ to 11 tons an acre with from 14 per cent. to 15 per cent. of sugar. Adding 25s. for rent and 23s. carriage, we have £10 13s.

A German agriculturist in a district where labour costs about what it would be likely to do in England says his expenditure is £10 0s. 9d., and rent and taxes. He is close to a factory and has good beet soil, but not the best. He grows about 2000 tons. His sugar percentage is from 16 per cent. to 18 per cent. and he spends from £2 15s. to £3 7s. 6d. on artificials and probably uses dung. If we add £2 for rent, rates, and cartage, the total is £12 0s. 9d.

In the Statement of the Objects of the German Sugar Law the agricultural cost of sugar beet is put down at about £9 12s. per acre. Wages are now at least 25 per cent. higher, Dr. Rabbethge kindly writes, and he would suggest £11 18s. But "many farmers are at greater expense, sometimes from £16 to £19. On our estates we also have the expenditure of from £16 to £19 including everything. But the crops are correspondingly higher."

Averaging now all the German estimates per acre:

	£	s.	d.
Geschwind	11	11	11
Near Halle	14	1	9
Near Breslau*	9	17	4

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* In the neighbourhood of Breslau labour is not so expensive as it is in the best beet growing districts. Labour and rents vary considerably in Germany, as they do in England.

	£	s.	d.
West Prussia	12	10	0
Hanover	10	18	0
Brunswick	14	5	6
,,	9	10	0
Prof. Dr. P. Holdefleiss, Halle	13	12	0
Westphalia	9	17	7
Harz	10	13	0
"German Agriculturist"	12	0	9
Dr. Rabbethge at only	11	18	0
12)	140	15	10
We have an average cost in Germany of at least	£11	14	7

If, as in the case of the English figures, we take the estimates which show rent and taxes, cartage, and manuring separately—there are three of them, Geschwind, Halle, and Westphalia—and deduct these items, the average is £4 1s. 6d. against the £4 3s. 1d. average of the English estimates similarly treated—a noteworthy result.

On ninety-eight German farms the cost of producing a ton of beet between the years 1893 and 1898 amounted in round figures to (Board of Agriculture *Journal*):

		s.	d.		s.	d.
On	3 Farms	12	6	to	14	6
,,	4 ,,	14	6	,,	16	6
,,	15 ,,	16	6	,,	18	6
,,	25 ,,	18	6	,,	20	6
,,	22 ,,	20	6	,,	22	6
,,	9 ,,	22	6	,,	24	6
,,	9 ,,	24	6	,,	26	6
,,	5 ,,	26	6	,,	28	6
,,	4 ,,	28	6	,,	30	6
,,	1 ,,	30	6	,,	32	6
,,	2 ,,	32	6	,,	34	6

On most of the farms included in the figures the cost of producing a ton of beets lay, therefore, between 16s. 6d. and 22s. 6d. Mr. Bennett writes:

> I should say that the cost of producing a ton would never come to more than 22s. unless the crop is a total failure. How are the beets to pay if the cost of production exceeds £1 a ton? The farmer would get no money return, and at anything over 25s. would lose money. I take it that the 22 and 25 farms represent the actual cost nearer than any others for crops between 10 and 12 tons. If the farmers get a bigger crop, then the profit is more, while the expenses are about the same.

The figures are now several years old. Labour-saving implements may have reduced somewhat the cost of production. A Saxon correspondent, who says he has reckoned everything, puts his expenditure in 1910 at £1 1s. 2d. a ton on a crop of 10 tons, and says the cost would have been nearly the same on a larger crop.

A Hesse correspondent gives me the following as his expenditure per ton:

	s.	d.
A crop of 15 tons an acre costs	9	2
,, 14 ,, ,,	10	0
,, 12 ,, ,,	11	7
,, 11 ,, ,,	12	8
,, 10 ,, ,,	13	9
,, 9 ,, ,,	15	2
,, 8 ,, ,,	17	0
,, 7 ,, ,,	19	6

To these amounts must be added not only rent and rates, but the cost of taking the beets out of the field. "As the cost of carting and sending is so different in various places," this item is very properly omitted in his return. In this particular case the factory pays the carriage of all roots sent by rail, up to 15 miles. After that the grower has to bear his share of the expense. The average crop of this correspondent is 10¼ to 13¾ tons. (His best land has been known to produce 20½ tons and his worst 7½ tons.) His average sugar percentage is 15 per cent.*

"In Germany," says Dr. Schack-Sommer, "they spend £2 to £3 an acre for artificial manures."

Field Labour Abroad: Germany.—As to the cost of field labour on the Continent, the Maidstone Farmers' Club delegates in Germany in 1910 found Poles and Russians at work. But wages are not low. The women labourers, what with the money paid them (1s. 8d.) and their housing and firing and allowance of potatoes, cost 2s. 6d. a day for singling. Hoeing costs 4s. 6d. per acre. As to raising the crop, on light land pulling behind the plough and topping costs 16s. On heavier land, where the roots were dug by hand, the cost is 30s. Mr. A. O. T. Bennett, writing in the *Farmer and Stockbreeder* after seventeen years on a German beet growing farm, says:

> Nearly all the work on a sugar beet farm in Germany is done by imported labour; the usual farm hands would not be sufficient to cope with the extra work entailed. These hands remain in the country from the middle of April till October, and are usually accommodated in specially built houses. Over half a million men

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* This correspondent's factory does not allow roots to be grown on land that has been folded with sheep, that has had liquid manure, sewage, or fresh dung. Further, land must not be used after clover, lucerne, or sainfoin, or be of a permanently wet nature, or have too much saltpetre in its composition. Artificials which have been approved by the factory may alone be used, and no top-dressing is permitted. This correspondent uses about 2½cwt. phosphates and 2¾cwt. nitrate per acre, or 4¼cwt. in all. Some neighbours use more, but the manures are usually bought through the factories, as they can buy more cheaply than individual farmers. The quantity of manure used may not exceed a certain amount.

> and women are required yearly. [They are chiefly Poles from Russia and Galicia (Austria.)] One person can work from 2½ to 4 acres of beet. When they are not employed in the root fields other farm work has to be found for them.
>
> Prices are reckoned at the rate of 1s. 9½d. a day for men. 1s. 4½d. for women, and 9½d. for children. The women do most of the hoeing and the children all the singling; adults are not much use for this work, as they cannot stoop as well as the children, who in dry weather do most of it on their hands and knees. The extra expense in England will be heavy, as we cannot get children for the work. In Germany they allow children to leave school to work in the fields during singling time, in most cases for half a day only.

"These are low rates," Mr. Bennett writes to me. Extracts he has kindly sent to me from letters from three German correspondents show that lifting and throwing into heaps and covering with leaves does not cost them more than from 15s. to 17s. 6d. per acre. They do it for 14s. 6d. in some cases.

Denmark.—In Denmark I also saw Poles and Galicians "making the beets." In 1907 there were 6251 Polish and Galician women and 1870 men employed in the country. Mr. Rider Haggard, who visited Denmark a few months after I did, witnessed the beet harvest, and, in his instructive description, reproduced in Chapter XVI., speaks of the women getting 3s. daily, in addition to milk, potatoes, and housing in the farm bothies. With regard to the total cost of cultivation which he mentions, he has very kindly turned up his note, which is as follows:

> Cost of cultivation including everything, thinning, delivery, cleaning (three times), fares of girls from Russian Poland (£2 5s. each return), their wages and food, £6 10s. per acre.

To these expenses, Mr. Rider Haggard assumes that there must be added, if first ploughing is included, " the

The Women and their Ganger

Ox Teams

Scenes in Bohemian Beet Culture

Hoeing—Harrowing—Ploughing out the Beet. (Seven Teams at Work) cost of the manuring and of the rental value of the land, which would be high."

Holland.—In Holland I have not found field wages lower than in East Anglia The cost of some of the operations connected with cultivation and delivery is given as follows, in a memorandum supplied by the Dutch Department of Agriculture :

Sowing sugar beet, about 1s. 4d. per acre.
Weeding, thinning, &c., about £1 per acre.
Lifting, about £1 to £1 6s. 8d. per acre.
Loading into waggons or boats, about 3d. per ton.
Harbour dues, about 3½d. per ton.

The wages vary with the season, but are largely made up of piecework. The average in South Holland is said to be about £33 a year for an ordinary labourer. Rent may be put at approximately 45s. to 50s. per acre on a seven-year lease, but this covers the payment by the landlord of polder and other dues, which are considerable. The State land tax of 6 per cent. on the estimated rent is also paid by the owner.*

United States.—"The seed, preparation of the land, and cultivation of the land"—that is, the cost of the crop, less harvesting and rent and taxes, is stated in the U.S. Department of Agriculture's Report to be from £6 to £9 per acre.

English Expenditure based on Foreign Experience.—The important thing about the Board of Agriculture and other Continental estimates is that they so frequently make the cost per acre work out at more than the £10 which has been so often stated to be the cost of producing beet in England, and is indeed given as the cost in the prospectus of the Worcestershire sugar factory. The Maidstone delegates drew up on their return the following estimate of the cost of growing beets here :

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* "Wages on the Continent have been steadily rising for years past, and in many parts are fully as expensive as in this country. In the Magdeburg district of Germany 900 Polish women, imported every year, cost about 3s. a day."—LORD DENBIGH, May 13, 1911.

	£	s.	d.
Dung, labour only	1	5	0
Once ploughed, four horses	0	18	0
Twice balked, three horses	0	12	0
Four times harrowed, two horses	0	3	4
Twice rolled	0	1	8
Seed, 16lb.	0	8	0
Drilled	0	2	6
Artificials*	1	0	0
Hoeing and setting out	1	10	0
Lifting	1	10	0
Carting three miles	1	2	6
Rent and rates	1	15	0
Bills, &c.	0	5	0
	£10	13	0

Mr. Anton Schobloch (in the *Estate Magazine*), after quoting the £13 12s. per acre calculation of Prof. Dr. P. Holdefleiss, of Halle, Prussia, has, with the assistance of Mr. Hunt, of King's Somborne, Hants, converted the details of the expenditure into English equivalents as follows :

	£	s.	d.
Stubbling, surface only, two sharer	0	6	0
Ploughing 12-14in. (two pair of horses at 16s., ¾ acre per day)	1	0	0
Dragging in spring, two horses, twelve acres a day	0	0	8
Harrowing crossways, two horses, twelve acres twice a day	0	1	4

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* One of the signatories of the report has suggested that succeeding crops would be laid if more artificial were used.

ACC No. 1987

	£	s.	d.
Rolling, two horses, ten acres	0	0	10
Harrowing, as before	0	1	4
Rolling, as before	0	0	10
Drill	0	1	6
Light harrowing	0	0	10
Rolling	0	0	10
Flat-hoeing, thinning out, and hand-hoeing (three hoeings)	1	10	0
Horse-hoeing previous to thinning out	0	1	9
Lifting by plough, hauling, clamping, and covering with earth (the latter not necessary if the roots are immediately taken off to the factory)	1	0	0
Putting on carts (say your crop is fourteen tons, which is excellent)	0	3	6
Carting of roots to the station (say one pair four times a day, two tons in waggon)	0	14	0
Carting of leaves to dairy or silo (say four tons)	0	8	6
Seed (28lb. per acre, to be supplied by factory or association at an average price of 4½d. per lb., the German price)	0	10	0
Manuring:			
Dung, 15 tons	3	0	0
Carting and spreading	0	12	6
18 per cent. super., 2½cwt. at 3s. 6d.	0	8	9
Nitrates (in spring), 3cwt. at 10s.	1	10	0
Spreading of nitrates	0	1	0
Rent	0	15	0
Extras omitted—10 per cent. of crop, value, say fourteen tons at 11d. per cwt. (Germany)	1	5	8
	£13	14	10

The rent is very low in this case. "The carting," Mr. Schobloch writes to me, "is here supposed to be done on the relay principle, horses being hitched from loaded to empty waggons, and *vice versâ*."

Mr. A. O. T. Bennett, referring to his transcription of a German estimate on a previous page, writes to me that for England he would add £1 10s. to the £9 17s. 6d. "until we are more experienced." Thus, his estimate would be £11 7s. 6d.

Mr. Cohen, whose Dutch estimate has been already given, has said:

> Sugar beet can be grown here as cheaply as on the Continent, if you work in a business-like way. If you take £2 10s. for rent and taxes per acre, and if you pay the same wages to unskilled agricultural labour as is now the case, your total costs per acre planted with beet, inclusive of the loading on waggons or lighters, will not be higher than £9 10s. per acre.* The average cost in Holland is £10 17s.

Surely Mr Cohen does not suggest that the crops are going to be produced 27s. an acre cheaper in Norfolk than in Holland? If he does, he should certainly explain why. £1 for transportation may presumably be added to his £9 10s.† The average of the Cohen estimate, at £10 10s., the Schobloch estimate, retaining it at £13 14s. 10d., the Bennett estimate of £11 7s. 6d., and the Maidstone delegates' estimate of £10 13s., is £11 11s. 7d.

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* In his contract with the farmers "labour is to be provided at the farmers' cost for the lifting and handling, such cost not to exceed 20s."

† "I am willing to guarantee a profit of at least £3 per acre to those who will grow in 1911 plots of 25 acres [later 10]. This means, I guarantee a revenue of £12 per acre, assuming that the cost of production and delivery to rail or water are not more than the normal figure of £9 per acre. The revenue will be, however, higher where I could be assured that at least 15 tons per acre will be grown on ground approved by my expert. Including £1 as the value of leaves and tops left on the field, the net profit should be £5 17s. 6d. per acre, at a price of 18s. 6d. per ton. I give, further, free seed and seeding."—*Eastern Daily Press*, April 5, 1911.

CHAPTER XIV

THE PROBLEM OF CUTTING IT DOWN

Labour.—It is obvious that it is by keeping down the labour bill that a great deal of Continental beet growing is made to pay. I recall a remark of a distinguished English agricultural authority to me: "I am not much in love with the crop, for it seems to me to be a cheap-labour industry." But we want rather to get away from cheap labour in the country than to have more of it. On the Continent, as we have all seen, beet is often a smallholder's crop. So it may be quite usefully here. But it is also undoubtedly a large farmer's crop. Every visitor to the Continent can see that. "In Germany," a well-informed correspondent tells me, "the largest portion is grown on big farms, mostly belonging to the factories or large shareholders." I have also seen it stated that half the German crop is grown by the factories. It is large farmers chiefly who have been appealed to here in connection with the factory schemes. Will these large farmers be able to save labour in competition with some Continental competitors by the greater use of horse power and by some use of steam or petrol power? They certainly cannot hope to do better than the large German farmers, who take every advantage that power and up-to-date implements can give them.

Drills and Hoes.—In France a competition is announced in order to discover the best means of employing motor power in hoeing the beets. There are numbers of ingenious machines in use on the Continent for hoeing, &c., but whenever pictures of them are shown to agriculturists here they usually say that every country is likely to have the drilling, hoeing, and thinning machines it finds most convenient, that our machine-making has reached a high level, and that we need new implements merely for lifting. In this country, however, we have not hitherto grown sugar beet seriously.

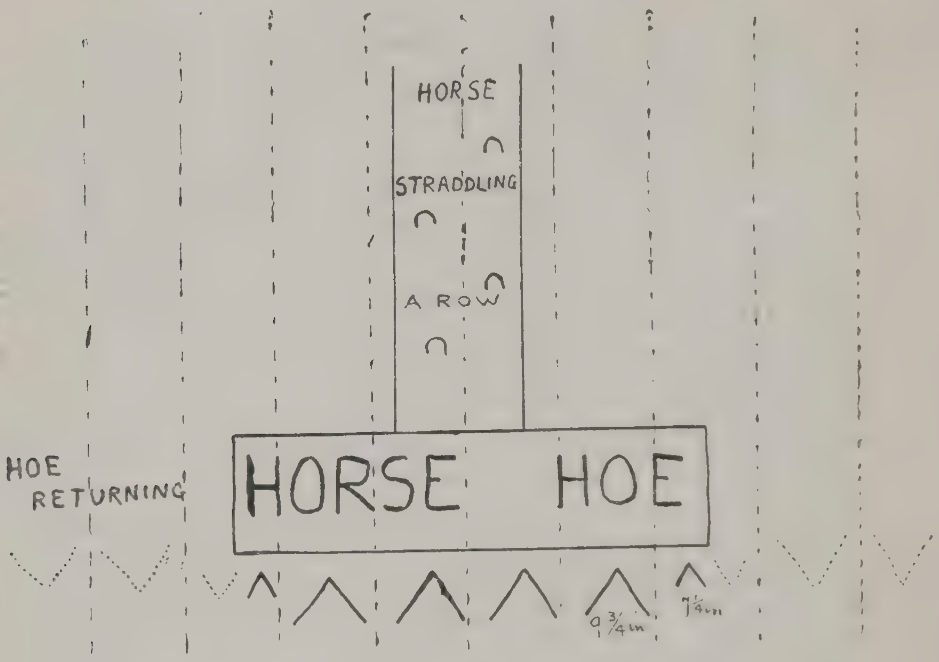


Diagram of Dutch Horse-Hoe Working in Beet.
Rows 13-14in. apart. See photographic illustration for guard discs which keep the plants from being smothered by the hoed soil.

Here is a short description of the Dutch drills and hoes imported by Mr. Cohen, sent me by Mr. W. E. Sawyer (who kindly supplied the photographs and diagram explanatory of their appearance and method of working):

The drill itself is a general purpose drill, as used for all crops in Holland, and, being fitted with a front steerage governed by a lever at the back, one man can attend to the drilling and the horse at the same time. This is made easy on account of the way the horse is attached to the hinder part of the drill. It allows much liberty, and really requires simply to be kept going more or less in the right direction. We drilled five rows at a time, some 14 inches and some 13 inches apart, and our local team men, after very brief instruction, were able to drill perfectly straight. The putting into and out of work for turning is controlled by one general lever and so is easily within the drillman's reach. When all drill coulters are working, the drill takes 11 rows and is capable of drilling about 12 acres per day.

The horse-weeding machine, of which there are three imported for use here, is in some respects very like our ordinary horse-hoes, but in special points unique. It has four large Λ hoes, 9¾in. for the middle four rows, and two Λ hoes 7¼in. for part of the outside rows. These 7¼in. hoes go back in the same row and finish it off. The steerage is by means of a rack and pinion on a slanting pipe with two handles, and in working it is necessary to keep the centre row of plants exactly under the end of the steerage post, which is very easy after a short trial. The most revolutionary part is that the horse should walk on or straddle legs down the middle row, as per diagram. The experts assure us that no damage will be done by the horse's hoofs, and certainly while the plants are small this seems correct.

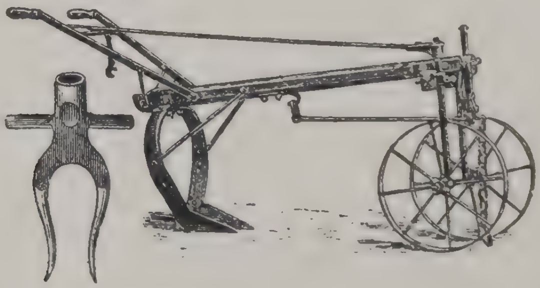
The greatest novelty of the whole is the patent guard discs, circular sheets of steel attached to the shank of the hoe. They form a wall either side of the tiny plants, and efficiently prevent any mould from running up the hoes and smothering the beet. The rough cutting out is to be done by running this machine crossways over the rows and then finishing off by hand singling.

The field in which the new hoe was first tried for weeding was hardly a fair trial, as it was rather stiff loam and very rough, but the hoe was an eye-opener to local farmers of Dutch ingenuity. There are two ways of attaching the guard discs to the hoe. On the whole the No. 1 is the simpler to adjust. But No. 2 is what we have been using and is shown in the photograph.

The Digging of the Beet.—The raising of beet was described by one East Anglian farmer as "an awful business." The root is not standing right out of the ground like a mangel; it is in the ground like a parsnip, and its side roots enable it to hold on. The special beet-raising forks imported from Holland were found to be quite useless. The imitations of them that were used were made at Birmingham of twice the strength. In an endeavour to discover some way of ploughing out the beets, one grower got a subsoil plough at work for a few hours at 9in., and, though he did not do the pair of horses at work any good, he turned out the beets quickly, though with the loss of their valuable tails.

German, Dutch, and Danish Practice.—It is well known that when beets are grown in large breadths in Germany steam pulling is resorted to. The Maidstone delegates write:

> On the heavy lands, when wet, there is at present no plough that can be used, but on the light lands there are several varieties of implements that are of use. They travel under the roots and sever the tap roots (*sic*). The beets are then pulled out with ease by women, who throw four rows into one—all laid out symmetrically—



Head of Fork Used in Digging Beets and a Horse Plough for the Same Purpose as used in Germany.

and they are, as they lie, topped with a butcher's cleaver.* On the heavy lands they are dug with a two-pronged fork by women. The cost of this is 30s. an acre; no bolters (shooters) are taken by the factory. The roots are then heaped up and covered with the leaves, or else lightly earthed over if the factory cannot take them at once. This is done to protect them from frost and sun, either of which is harmful.

As to the ploughing out of beet with horses, several makes of ploughs were experimented with at the Hollandia factory in 1910, with a view to the most effective being recommended to growers. Such harvesters loosen the beets from the ground, and they can then be easily pulled out as wanted.

Mr. Rider Haggard describes a beet plough he saw at work more than once in Denmark:

> It is a curious instrument consisting of a straight share measuring about 18in. in length by 12in. in depth, and fitted with a rising iron tongue which lifts the root from the ground. This plough is used in dry weather when hand-pulling is difficult. I was told that it does its office well, but is only employed in cases of necessity, since, having to burrow so deep, it is hard on the horses. Moreover, the hand-pulling leaves the land in a better state.

Motor Power.—Under the system of lifting beets followed in the Eastern Counties raising cost in not a few cases almost as much as cultivation, sowing, hoeing, and singling put together. It is clearly under this head, raising, that economies are to be made, if made at all. "The Progress of the Beet Sugar Industry in the United States in 1909," published by the U.S. Department of Agriculture, says:

> Harvesters have been devised for lifting the beets, topping them, removing the larger portion of the dirt, and elevating them into a waggon for delivery to the factory. Their use is increasing. Different

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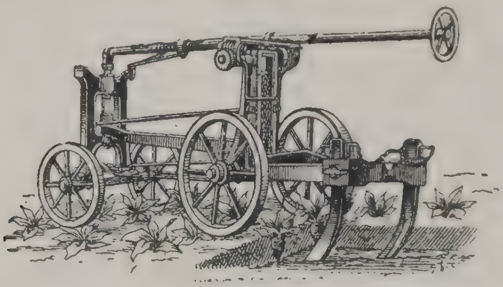
* All sorts and shapes have been adopted for topping knives.

devices of this kind have proved their efficiency. They will be more generally used. It appears probable that eventually traction engines will be used extensively to propel beet harvesters. Steam and electric power are coming actively into use in the sugar factory districts.



GERMAN IMPLEMENT FOR HARVESTING BEETS.

This machine is hauled by engine power, like a steam plough. Some of the steam beet ploughs have feet exactly like the American beet plough on page 169.

Traction engines are very much reducing the cost of delivery. A train is made up of a number of loaded beet waggons and hauled to the factory.

It is interesting to remember that James Duncan, who started the Lavenham sugar factory (1870), suggested motor traction for carting roots.

In the United States many of the waggons used for the transportation of the beets are made so that they can be racked up for dumping. The use of waggon nets (with a heavier rope round the edge) is also common. To fork out all the beets at the factory or railway station is, as stated, "a hard, tedious process."* New inventions for lightening labour and reducing the expense of cultivating and harvesting beets appear in almost every number of the American sugar trade papers.

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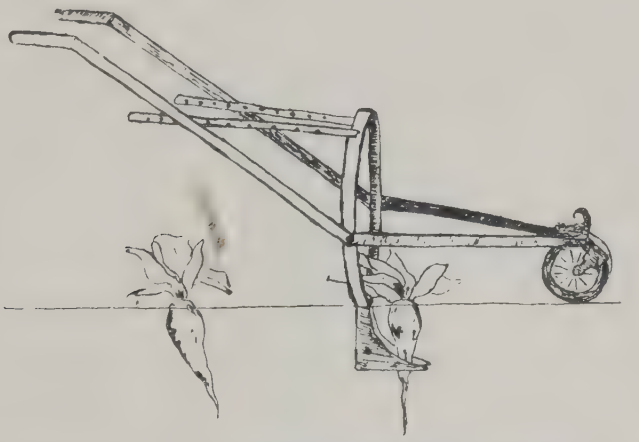
* The beets are dumped on a grating, to slide into the railway cars, and so lose some of their dirt.

FORKS.—In the States beet forks have their tine points protected with balls of steel, as shown in one of the Dutch photographs, so that the roots shall not be injured.

Heavy Land on the Continent.—In East Anglia, 1910 was, of course, a beet year for holders of light ground. The dry October and wet November made raising most costly on the clay. Possibly, if the ground had been better prepared for the crop, raising might not have been quite such hard work. As to the advantages enjoyed by growers on light land, it remains to be seen how they will fare in a season of drought. No doubt there is plenty of light land in Prussia where a large quantity of beet is annually grown; but then the Prussians have twenty years' experience of the crop. On heavy ground in East Anglia there are two difficulties, in addition to the cost of harvesting. First, there is not likely to be a heavy crop during the first few years in which beet is grown and the depth of the soil is being increased; second, a good deal of this heavy land is at a distance from the ports of export. There is certainly no immediate prospect of beet being grown on heavy



A Rough Sketch of a Continental Beet Harvesting Plough.

land in East Anglia. There is, however, a large area of light soil within the 2s. a ton for carriage radius of Maldon. As to the cost of cultivation on heavy land, a Dutch correspondent writes:

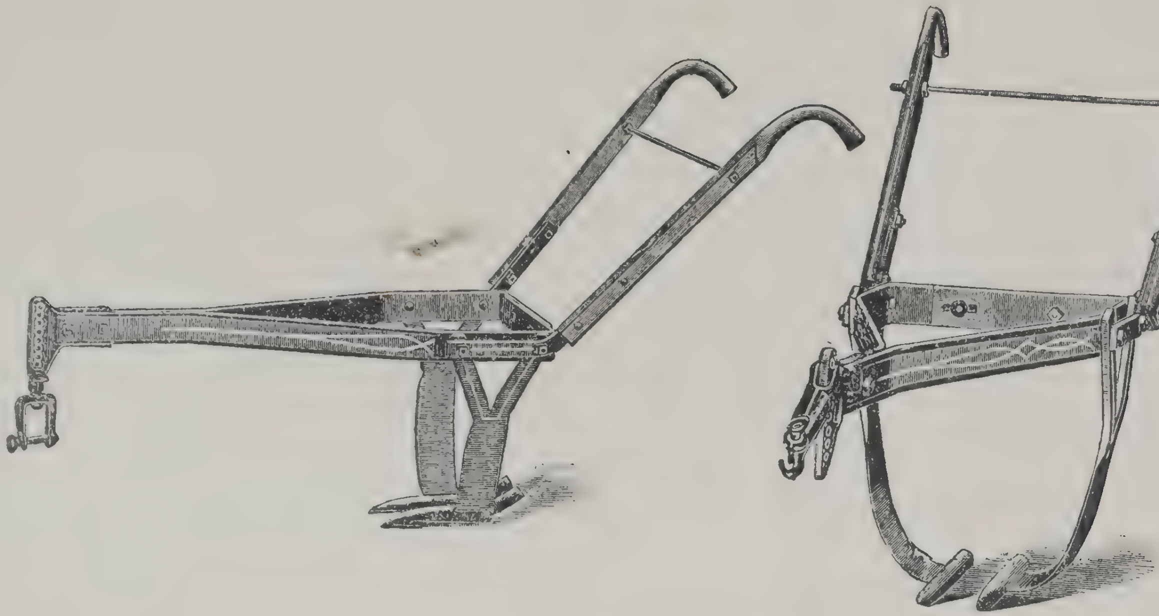
> On some of South Holland and Zealand the ground is not ploughed deeper than 10in., and the subsoil (sea clay) is as heavy as in England. Yet it has never occurred that in times of dry weather it was impossible to raise the beets. What happens is that the farmers want rain to be able to do the raising more easily.

The maps of Holland showing the beet districts (pages 70-72) exhibit a range including a great deal of the kind of land in East Anglia.

In Germany, I am assured, "the beet is now grown practically everywhere, heavy clay, sandy loam, and sand." A correspondent of Mr. Bennett's in Germany has to pay carriage on soil over 20 per cent. In dry years he has not more than from 10 per cent. to 15 per cent., but in 1910 he had 40 per cent. and a friend had 60 per cent., at exceptional times when the land was very wet.

American Beet Pullers.—A bulletin of the United States Department of Agriculture deals with the harvesting of beets. It says:

> The ordinary beet puller is used where there is sufficient moisture in the soil, or its nature is naturally loose, and it can be run to a depth sufficient to move the roots without breaking them near the surface and thus wasting a good portion of the crop. The prongs run either side of the beet row, and have a lifting effect which raises and loosens the beet. Two to four horses are required, depending upon the soil conditions and depths to which it is run. It is not sufficiently strong, however, aside from the damage it would do, to run in a hard, dry, clay soil. In such soils an implement called a "beet plough" is used. This consists of a heavy steel standard somewhat similar to a subsoil plough, to which are attached, at the bottom, a ploughshare and land slide, the mouldboard being absent.



AMERICAN BEET HARVESTING PLOUGHS.

> This plough is run as close to the row as possible, with the land slide next to the row so as to prevent cutting the roots. Four horses are attached, and it goes to a depth sufficient to loosen the soil so that the beets will come out as nearly whole as possible.

Another implement is used in large fields:

> It is very heavy, and six rows are pulled at a time. It is used in connection with the double engine ploughing outfit, and is handled in the same way as the balance plough—that is, an engine is stationed at either end of the field, and the puller is drawn back and forth between them. The lifting or cutting tool is of the order of a duck foot or sweep, with wide side wings made of heavy material. It is run to a depth of 18in. to 24in., and cuts the roots off at that depth, as the wings overlap and cover all the ground below between the outside extremities. As much as 30 acres per day can be pulled with this outfit.

Topping.—It was not only the harvesting, but the topping of the beets that gave trouble to the East Anglians. In Holland the men who pull the beets top them by laying them on one of their *sabots* (or rather *klompen*) and striking off the head on that hard surface. In 1910, I was told by someone who ought to have known what he was talking about, that the company would offer growers a topping apparatus on the principle of a bread-slicing machine. My informant assured me that it was estimated that a man would top a pile of beets in a seventh of the time he would need were he working with a bill. But this, I learn from Holland, is all nonsense! "The statement that a man will top beets at such a rate is repudiated by practical men. It is bad practice to bring all beets to one spot to be topped or to take a topping machine up and down a field. The desire to have a topping machine is due to inexperience."

In some parts of Germany a topping knife like a kitchen meat chopper is used. The beets are laid in rows, as shown in one of the photographs, and Mr. Bennett writes, "topped as fast as one can get from one beet to another. A little pressure is necessary. This work is nearly always done by women. If they work in gangs, some lift and some top, and then change about, and so lighten labour. A bill would not work nearly as well as the tool they use." "The particular instrument used makes very little difference," writes a Continental correspondent; "practice is everything."

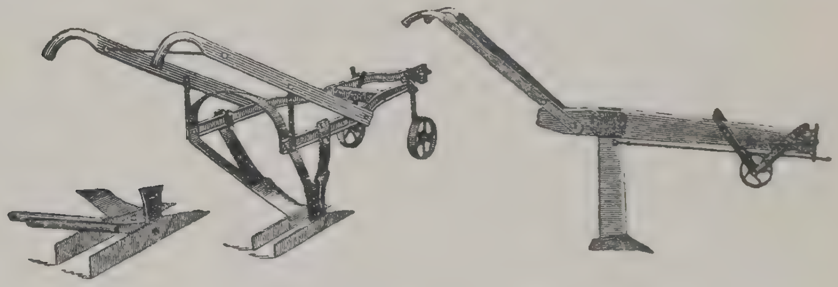
Some particulars may be usefully added of American practice in topping:

> After the pullers or ploughs come the toppers with their long, heavy knives. Their first work is to throw the beets into piles or windrows, after knocking them together to remove dirt. Six or eight rows, either side of the pile or windrow, are thrown together, and when the toppers are up to the puller or plough they go back to top the piled beets. One man is given a rake or hoe, with which he clears and smooths the ground between the windrows or piles upon which the topped beets are to be thrown, so that in forking them into the waggon no foreign matter will be included. The topping consists of removing, with a blow of the knife, the crown of the beet at the point of the lowest leaf and throwing the topped beet on the cleared space.
>
> Picking the beets up for topping by either slashing into them with the knife or having a sharp hook on the end of the knife for this purpose is forbidden by most factories, especially in the colder climates, as it has been found to cause rotting of the roots thus injured. If they are picked up in one hand and topped with the other the work is just as rapid.
>
> Where the pulled beets are thrown into piles a pile of topped beets is placed in the centre of a square of four piles of untopped beets. If the pulled beets have been thrown into windrows, the topped beets, from 20ft. to 25ft. in two windrows, are thrown together into a pile. The disadvantage of the windrows is that the topper has to keep moving to reach the beets, while when the beets are in piles they are close at hand, and he may kneel at his work. Sometimes the beets are topped as they are pulled from the row, and thrown either into a waggon or into piles; but the method first described will be found to

take little more time, if any, than the latter, while there is no comparison between the results. Care should be exercised that the pullers or ploughs do not get too far ahead of the toppers, as it is desirable that the ploughed-out beets should be cleaned up each night. Those which are left are covered with beet tops.

Here is an account of a new beet topper which appears in the *American Sugar Industry and Beet Sugar Gazette*:

It was a great surprise to us to see how perfectly the machine works. It tops about 300 tons a day, and loads them on to a waggon. According to our own observation, we figure this work is done, topping and loading, at about 25 cents a ton. The construction of the machine is very simple. Of course, the machine we saw is built for a large acreage, but we decided this machine also could be manufactured for small tracts of, say, five and ten acres. The machine we saw tops about twelve beets at once; there are link belt chains with some kind of bucket attachment to hold the beets in position, which are put in this bucket by men. This chain carries the beets up at about a 45 degree incline; near the top is something like a circular saw, which runs very swiftly, and cuts off the tops; the tops drop down to the ground and the beets go up and drop on a belt conveyor. This belt carries them across the machine and drops them into a waggon which goes alongside the machine. The whole driving operation is performed by a gasoline engine, which is attached to the machine direct. One man tends to the operation, and there were about twenty men putting the beets on the elevator; by working as fast as possible they could not crowd the machine. This is about the only machine that will do successful work in topping and loading beets.



AMERICAN PLOUGHS FOR HARVESTING BEETS.

CHAPTER XV

THE BEET SUGAR INDUSTRY AT CLOSE QUARTERS

Dutch Farmers and Factories.—The only crops of beet grown in this country in commercial conditions have gone to Holland. It is a country in which there is, in proportion to area, not only a large beet acreage, but a large number of sugar factories. Agricultural rents and labour costs are not greatly dissimilar from our own, and, as far as agricultural products are concerned, the Netherlands is, like Great Britain, a Free Trade country. As many readers interested in the proposals for beet cultivation and sugar factories in England may well wish to have a view of the sugar industry at close quarters, and as everyone is not able to spare the time to make personal investigations in Holland, I have thought it might be of service to translate some notes on beet growing and beet sugar making in that country from what is recognised to be the most authoritative work on Dutch agriculture, the "Agrarverfassung und Landwirtschaft in den Niederlanden" of Dr. Frost, published in the autumn of 1906. As the statistics used by Dr Frost are necessarily out of date, I have added at the end the latest figures, which have been kindly procured for me by Dr. J. J. Van Ryn, Agricultural Commissioner for the Netherlands in London. I have also inserted four notes sent me by a Dutch manufacturer to whom I sent a proof.

The Friction Between Growers and Manufacturers.—Not long ago, Dr. Frost begins, business relations between beet growers and sugar factories were of the worst character. The manufacturers were better business men than the farmers, and took advantage. As the growers had not the slightest control over prices, the manufacturers could do as they liked, and used to pay the growers what they pleased for their produce. This led to an intolerable situation.*

For example, the manufacturers supplied the growers with beet seed without specifying its variety. This was sown, and in the autumn the grower had the unpleasant surprise of harvesting small beet containing a high percentage of sugar, but weighing very light. As he sold his beet by weight he was the loser.†

Another means by which the manufacturer secured small beet rich in sugar was by fixing the time of supply very early, say, in the middle of September.

The payment in advance system was grossly abused. The growers could generally get as much payment in advance as they liked from the manufacturers for their beet. Thus the manufacturers secured for themselves the harvests of the following year and had the growers in their power. In time these conditions led to such a conflict of interests between grower and manufacturer that the two looked upon one another as enemies.‡

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* "I have never heard that the manufacturers paid the farmers the price they liked. On the contrary, I have always heard of an intolerable competition between the manufacturers which brought the price up to a level that no manufacturer made a profit."—A Dutch Sugar Manufacturer.

† "As long as we can remember, the farmers knew which variety of seed they got. If we have to go back so far that a Dutch farmer did not know exactly which seed he wanted, it must have been in the time when the manufacturer knew no better themselves, and so could not take advantage of it."—*Ibid.*

‡ "The payment in advance system is indeed grossly abused, and unfortunately it has not been the manufacturer who advanced the money who secured the harvest of the following year. It was the competition between the factories for the beets for the present year

Of late years matters have somewhat improved. The growers have tried again and again to get control over the price to be paid for beet, and have here and there deliberately limited the supply in order to force the hand of the manufacturers; but the old bad relationship has not yet been completely overcome. One often still meets growers who regard the sugar manufacturers as their economic enemies, and say that farmers have not the slightest control over prices. If sugar prices rise the manufacturer gets all the advantage; they (the growers) do not get more for their beet.* How much truth and how much shortsightedness lies in this view should be gathered from the following facts:

Payment for sugar beet is made in four different ways at the present day, viz.:

1. By weight;
2. By weight and percentage of sugar;
3. In shares;
4. By division of profits in a co-operative factory.

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campaign that made the farmer secure each year as big an advance as he could. To show you how much competition there has been and how the farmer has been nursed by the manufacturer, we can tell you that to-day, after the Factories' Association has existed several years, there is still a debt of £9000 to be paid by the Gelderland farmers to the factories. The factories are now trying to get it back by deducting a small part each year, and not allowing the farmers to change from supplying one factory to another until their debt has been paid."—A Dutch Sugar Manufacturer.

* "The delivery of the roots to the factory was at one time a sad source of disputes and friction, but habit has pretty well overcome this friction. The farmers and the factory now understand each other better. The farmer is bound by contract to use the best seed, and the right kinds of manure, and to deliver the roots clean and well trimmed. If Germany in a good year can make an average yield of nearly 17 per cent. of sugar it is certain that nothing but first-class roots have been delivered."—"Sugar" (Martineau).

Payment by Weight.—The first form of payment is the oldest. What happens is this: the seed is supplied to the growers by the factory, and it is agreed that the name of the variety of seed shall be given in the contract. The former advantage taken of the growers in the delivery of seed now rarely takes place. It is to the interests of the growers to get their seed in large quantities from the factories, as smaller purchases come dearer, and are less convenient.*

The delivery of sugar beet to the factories has, as a rule, to be made between September 15 and October 20, free on board canal-boat or waggon. Estimates made in 1900 by twenty-three factories as to their output in transport charges reached a total of £131,412.

In payment by weight poor beet or beet with low percentage of sugar (*i.e.*, with less than 13 per cent. of sugar) is rejected.

The gross weight of the beet is fixed at the unloading depôt or at the factory, and a sample is taken of every four tons in order to fix the net weight. The beet is paid for according to this net weight.

If paid in advance at the signing of the contract, the grower can get from £5 15s. to £8 5s. per hectare ($2\frac{1}{2}$ acres), according to a stated scale. The price is fixed in the winter on the conclusion of the delivery contract. Payment is made, according to contract, fourteen days after the delivery of the harvest.

The grower has a right to wet slices to the amount of half the weight of his consignment of beet. These slices are forwarded to him from the factory free on board or waggon for 1s. 8d. per ton.

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* "This seems a contradiction of the first sentence of the paragraph. As far as we know the seed is sent free to the farmer, whether he be a small or large contractor."—A Dutch Sugar Manufacturer.

These are the important essentials of the Telquel contract. About half the beet grown in the country comes under some such contract, especially in places where the beet harvest is not sufficient for individual growers to send a boat-load to the factory, and several join together for a load. When this is done, differentiation in price according to the sugar-yield is difficult, and it is more convenient to measure entirely by weight.

Payment by Weight and Sugar Percentage.—The second means of payment is by weight and sugar percentage. The wider knowledge the farmers gained of beet growing, the more this system gained favour. One farmer compared his beet with that of his neighbour, and if his product seemed better he rightly demanded a higher price.

Under this system a sample is taken from every consignment of beet and is analysed to fix the percentage of sugar. A price is then fixed by an expert as an average: for example, 15s. per ton for beet with a sugar percentage of 14 per cent. For every unit over or under 14 per cent. the price is increased or lowered 1s. 8d. per ton. This system has come much more into vogue of late years.

A Sharing System.—Payment by shareholders' contract was in 1903 in use only in two factories. Both factories have in their contracts a schedule regulating the price of beet. The basic rate is 15s. per ton of beet with a sugar yield of 15 per cent.

In Oud Gastel it rises from 15s. per ton with a sugar yield of 14 per cent.

The grower is in this instance paid according to the net weight and sugar percentage of the beet, and at the same time in accordance with the temporary price of sugar. But this is not the special feature of this form of contract, for we find it stated:

"The growers shall receive, besides the payment fixed by contract as per table, a bonus fixed in the following manner: The growers send a commission of five members who yearly examine the books of the factory. Out of these net profits 1s. 8d. per sack of sugar is subtracted. This sum, in addition to 50 per cent. of the remainder of the net profits, is divided as follows : 5 per cent. goes to the shareholders in the factory as dividends, the remaining 95 per cent. being distributed as follows :

"30 per cent. to a reserve fund ;
"40 per cent. to the shareholders as bonus ;
"10 per cent. to the director of the factory ;
"10 per cent. to the inspector ;
"10 per cent. to the personnel of the factory.

"The 50 per cent. remaining net profits is divided among the beet growers according to the amount and yield of their consignment of beet."

This arrangement represents the effort made by beet-producers to strengthen their position. But the effort has certainly not been very successful. One gets the impression in reading such a contract that all the concessions on the part of the manufacturers are only made to mollify the growers.

Farmers as Sugar Manufacturers.—The most happy solution of the problem of the relationship between manufacturers and growers is for the farmers to be also the manufacturers. There is in Zealand a sugar factory which is a beet-growers' co-operative undertaking, *i.e.*, the factory of Sas van Gent.

On May 1, 1903, the number of members of this factory was 289. Each member is bound to take at least one share of £33, and for each share that he holds to deliver each season a minimum of 15 and a maximum of 20 tons of beet. On May 1, 1903, 1897 shares were issued. Besides this capital of £63,232 contributed by the growers, the factory has raised loans to the amount of £66,187. All the members have votes in proportion to their number of shares. A man having from one to four shares has the right to one vote ; from five to ten shares to two votes ;

if he has more than ten shares he is entitled to three votes. The members elect the council of inspection and a committee to examine into the yearly debits and credits. The factory was founded in 1899, and is fitted with machinery from German factories. The director of the factory is a German. Contracts are the same for all members. Each member receives from the factory 22½lb. of seed per share at cost price; he is allowed to choose among the best varieties of seed.

Consignments must be delivered between September 20 and November 25. The factory pays freight up to 2s. 6d. for one ton beet; all freight above 2s. 6d. to be paid by contractor.

Payment is according to weight and sugar yield. Each contractor can claim a certain weight of slices; the remainder is sold for the benefit of the factory.

In the season 1902-03 the factory at Sas van Gent worked 40,000 tons of sugar beet with an average sugar percentage of 15·8. The co-operative factory has in a period of three years paid 6d. more per ton than other factories.

When growers in general heard that the factory paid higher prices they demanded higher prices. Thus the co-operative factory had an influence on beet prices.

The Work of the Agents.—We may add to our analysis of the different contracts the statement of a man who lives among the beet growers and knows them intimately:

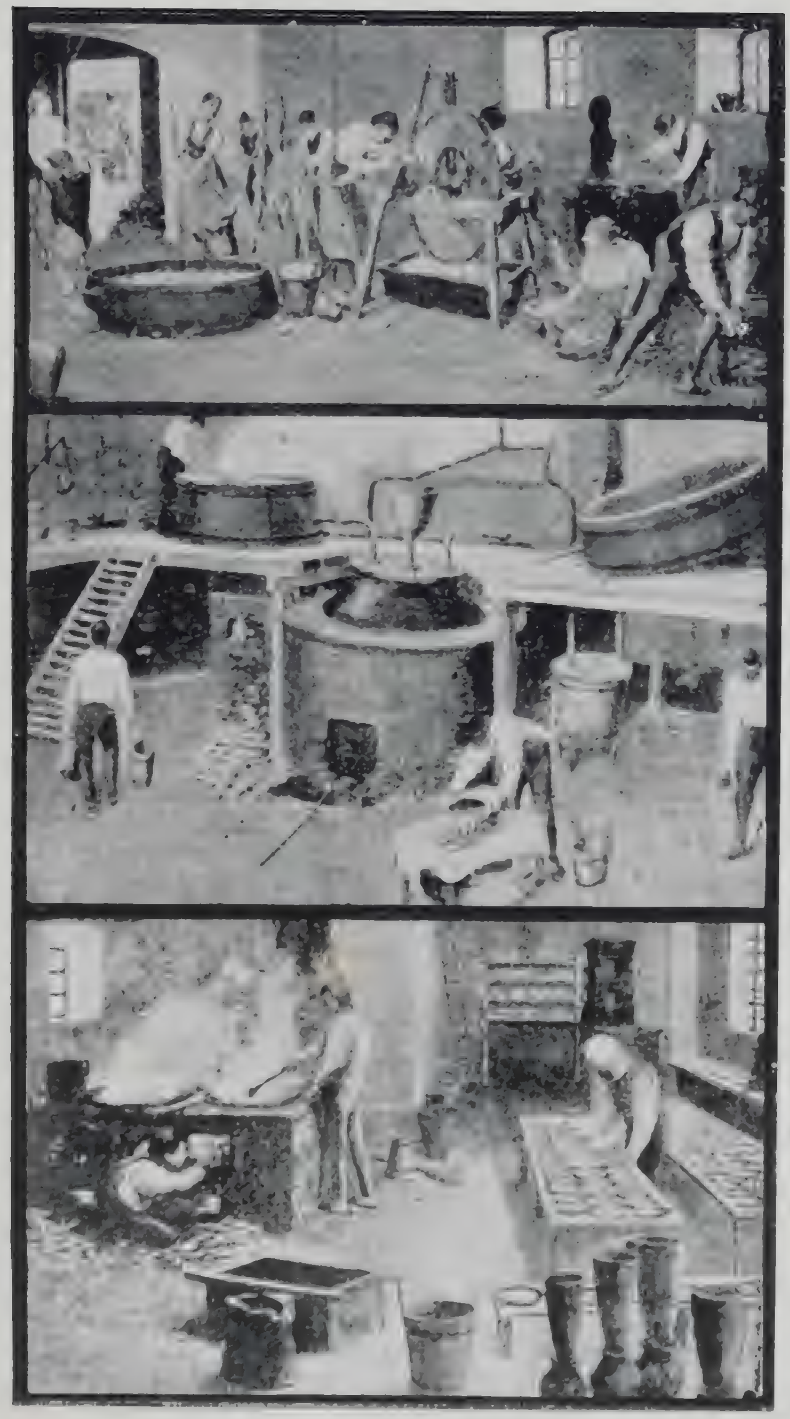
"If one compares," he says, "the different sorts of contract, and examines into how much each farmer gets for his beet, we find that it is everywhere much the same according to contract. But those who know farmers well know also that there are comparatively few growers who sell their beet according to these contracts. The contract lies carefully preserved in their bureau, and when the autumn comes an agent comes to the grower, lays down ready money on the table, and the beet is sold to him there and then as it is in the field. The middleman sees after delivery to the factory at his own risk; that is, the grower must sow the beet and dispatch it, and the middleman receives payment for it from the factory. Naturally the middleman makes the grower pay dearly for the risk that he has to run. Probably the grower is done out of from 1s. 6d. to 2s. 6d. per ton of beet by this system.

Many of the farmers contracting to supply beets to factories are small men. The factory can hardly be in direct communication with them. It therefore sends agents during the winter with the contracts, whose duty it is to get the custom of the farmers. In the autumn the agent has to see to the despatch of the beet, look after the transport, do the correspondence necessary, and see to the payment on behalf of the factory. There are over agents and under agents. The over agents live in town in the centre of the beet district, and the under agents live among the growers, and come in daily contact with them. The official pay which these agents receive is, for the chief agents 4d. and the under agents 3d. per ton of beet.

Importance of the Industry to the Country.—In the year 1903 there were in the Netherlands twenty-eight sugar factories, which worked a total of 1,000,000 tons of sugar beet. Leaving the directors, chemists, and other highly paid officials out of count, about 1000 hands would be required for the manufacture of the beet, who altogether would earn about £10,000.

Reckoning that in the year 1903 100,000 acres of beet were grown, and that this occupied one-sixth of the growers' fields, we find that 600,000 acres are used in part for beet culture; that is about 28 per cent. of the total arable land of the Netherlands.

But it is not only on account of the area covered that beet culture is of great importance for agriculture. Every-



The First Manufacture of Beet Sugar
Scenes at Achard's Pioneer Factory in the year 1799
1. Washing, pulping, and pressing. 2. Boiling and filtering.
3. Filling out the boiled mass into the loaf moulds.

where it is carried on the intensity of cultivation is heightened, the fertilisation of the soil is increased, and the cattle feeding is improved.

Again, the small shipping trade is greatly interested in beet production, for three-quarters of the harvests are transported by water, and one quarter by rail.* If one reckons the freight at 1s. 8d. per ton, the shipping trade makes about £50,000 out of this industry.

These figures show what an important *rôle* the sugar industry plays in the economic life of the Netherlands.

Total production of the Netherlands in sugar beet in the season 1901-2, 1,827,587 tons.

Manufacture of sugar in season 1900-01, 178,791 tons. By the importation of foreign raw sugar this rose in 1902 to 235,780 tons. The figures show that the Dutch sugar industry works chiefly for the foreign market. The chief market is England.

The consumption of sugar in the Netherlands for the year 1902 is estimated at 71,650 tons, that is 30lb. per head of the population. The consumption is partly to be accounted for by the high tax on sugar. [1907-8, 37lb.]

Latest figures.—I am indebted for the following figures to Dr. J. J. L. Van Ryn, Netherlands Agricultural Commissioner for Great Britain and Ireland:

The rate at which contracts for beets are made at present is from 19s. 2d. to £1 0s. 10d. per ton delivered at the factory. In the district of Haarlem the contract price is 17s. 6d. per ton for beet with 14 per cent. sugar, with an increase or decrease in price of 2d. per $\frac{1}{10}$ per cent. of sugar.

As to freight rates, they are by canal in Zealand 2s. 1d. per ton.

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* A certain amount of beet is delivered by waggon, but as canals of different sizes go everywhere, water carriage is to most growers the most economical method.—" H. C."

There are now two co-operative beet-sugar factories, one at Dinteloord and one in North Brabant. There are 29 factories altogether in the country. Some of them have been greatly increased in size. One which had a daily capacity of 120 tons of sugar in 1885 is now able to make 1400 tons.

The acreage of beet grown in 1909 was 55,000 hectares. The total acreage of arable land was 867,178 hectares.

The total beet yield in 1909 was 1,496,928 tons, with an average of 27,200 tons per hectare, *i.e.*, 10·88 tons per acre.

The quantity of imported beets is insignificant compared with the total. Some are even exported. The factories worked only 1,409,039 tons, which is less than the total production. Beets are exported to Belgium. The average percentage of sugar in 1909 was 15·52 per cent. The excise duty is £1 2s. 2d. per cwt., and there is no surtax on imports, that is to say that imported sugar pays the same contribution to the State as the home manufactured article.

By way of supplementing the data supplied by Dr. Van Ryn, it may be added that a report to our Foreign Office states that in 1910 the Dutch manufacturers were buying large quantities of beets in Germany, and were able to quote higher prices to the farmers than those offered by the German factories.

Mr. Martineau writes to me to explain that "Holland imports a large quantity of foreign sugar, because the refining industry is very well managed and has a large export trade, especially to the United Kingdom."

How Things are Done in Denmark.—Mr. Rider Haggard, in his book "Rural Denmark," describes a visit in 1910 to a field of 180 acres of beet. About 100 Polish girls are imported yearly by the owner of the farm in which this field is situated, who employs a special collector to hire, manage, and return them to their homes.

> "They arrive on the estate in April," says Mr. Haggard, "and are sent back to Poland at the end of November. Without the help of these women it would be impossible to deal with the beet crop, which is a fact that must be borne in mind in considering the possibility of establishing this industry in England, where, in most districts, the women will no longer work. Only women and boy Poles visit Denmark to do agricultural work; the men do not come.
>
> "I saw them at their toil in the field, and went up to two of them, for they appear to labour in pairs. They were curious, monkey-like girls, apparently about sixteen years of age, small, but very strong and healthy. One of them I noted had a pretty face. Their costume was of the simplest; a rough brown robe, under which I understand they wear little or nothing; their brown legs and feet were bare. They pull the beet with the right hand, and use the special fork with the left, driving it in with the naked foot. That is, the right-hand girl does this; but the left-hand girl labouring alongside of her reverses that order, using the left hand and the left foot where her companion uses the right foot and the right hand. They work hard and very swiftly, employing just sufficient force to get the root up and no more. Sometimes it is dragged from the soil by the hand alone, and sometimes the fork must be used to help it forth. I borrowed the instrument from one of them and took a turn at the business. As a result I found that I broke about one root in three, which caused these funny little creatures to giggle at my inexperienced efforts.
>
> "Another girl followed the pair, piling the pulled beet into heaps. When the tops have been trimmed off these they can lie in the open till the end of October, after which, if they have not been conveyed to the trucks and removed by the tramway, they must be clamped to protect them from frost. Further on were yet other women, who were engaged in cutting the tops off the beet."

And a Moral.—Speaking at Norwich in March this year, Mr. Rider Haggard said that his experience showed him that sugar beet could only be profitably grown if there was at hand a factory owned, or largely owned, by those who grew the sugar beet. Beet growing at the farm of which his description has just been given was unmistakably prosperous, but the owner of the farm was the owner of a very large proportion of the shares of an enormous factory near his estate. The factory, he was told, paid a profit of more than 20 per cent., and the farmer, who received £1 3s. 6d. a ton for the beet which he grew, told him that he made on the average, year in and year out, £3 an acre net profit on the industry.

Mr. Rider Haggard went on to say that he did not think that in this country women would undertake the arduous work of getting up sugar beet. He should not himself ever grow another beet crop for exportation, by which method they lost the *Schnitzel* (the refuse, which was one of the best cattle foods imaginable), because he could not see any profit in it; but when Mr. Cohen had erected his factory within reach of them, and had given them the opportunity of becoming co-owners of the property, and they had invested in it, then he thought it became an extremely different problem. There was a higher average of sunshine in Norfolk than in Denmark, and as to soil, he was satisfied there were tens of thousands of acres in East Anglia which would grow sugar beet quite as well as it could be grown in Denmark. But it would never pay farmers to undertake sugar beet cultivation until they saw the factories established in their midst and they had the opportunity of investing a little in them, so that they might get a little of the manufacturers' profit as well as their profit as producers.

Dr. Frost's excellent book on rural Holland is published by Herr Paul Parey, Hedemannstrasse, 107, Berlin, by permission of whom I am allowed to make my translation from the chapter on the sugar industry.

CHAPTER XVI

THE RETURN IN CASH

The Price per Ton.—On the Continent, as has been indicated in the previous chapter, there are various methods of paying for beets.

The Lincolnshire Company counted on getting its beets delivered at the factory at Sleaford at an all-round price of 17s. 6d. per ton, although it had a sliding scale by which beet would be entitled to 1s. per ton per cent. of sugar in excess of 15 per cent.

Under the East Sussex sliding scale scheme 15 per cent. beet would be paid for at 18s. per ton at the factory, 16 per cent. beet at 19s., and 17 per cent. at 20s. Mr. Courthope has stated, however, that he expected to have to pay 20s. for most of his beet. There was also a promise of free saturation lime, cheap wet and dry slices, and of a bonus after a certain dividend was paid.

The East Anglian Company, which also offered a bonus advantage, was open to make contracts for 20s. delivered at Maldon.

The Worcestershire Company has offered a uniform price of 20s. delivered at Kidderminster.

In practice it is unlikely that there would be any real difference between the rates paid by the factories.

In 1910 Messrs. Hummelinck paid for Dunmow beet 17s. f.o.r., and more at points nearer the coast. The beets shipped to the Arnhem Company were bought at 18s. at Great Yarmouth, or 17s. 6d. on quay (21 cwt. to the ton to allow for dirt). Seed was supplied both by the Hummelincks and by the Arnhem Company.

Mr. Cohen, who is interesting himself in a scheme for a factory in Norfolk, offers 18s. 6d. f.o.r., wharf or quay, for the 1911 crop, to be exported to Holland, and seed and help in drilling and harvesting. When the factory is built, £1 1s. 6d. will be paid at factory, or on rail, less carriage. These prices are, of course, in every case for clean roots.* There is also a promise of bonuses.

£6 to £7 Profit!—Early in 1910 Lord Denbigh suggested that there was a profit for the farmer in beet of

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* "Clean" Roots.—Mr. W. E. Sawyer, of Roughton, writes in the *Farmer and Stockbreeder* of his experience in harvesting as contractor for the Arnhem Company: "By lifting the leaves and getting a firm hold, and then putting the fork in and loosening the ground, it was possible to draw them without breaking the tap root. They were then knocked and laid in rows previous to being again knocked, topped, and thrown on the waggons to cart to the station. We found that knocking them when pulled, and again when topping and throwing on to waggons, removed most of the attached mould. The question of 'tare' did not trouble us much, as we delivered 'clean' roots, not scrupulously washed roots. Some factories, however [all factories, except in this special case.—H. C.], demand a great 'tare,' as they take a given weight of roots and wash them, then pay on the basis of the re-weight. I saw one instance of a grower who delivered 28 tons, and he had 4 tons 4 cwt. deducted for 'tare,' and I find on nquiry it is seldom less than 10 per cent., and often up to 20 per cent., and even more. So this is a great consideration when making terms to grow for a factory."

"It will be very seldom indeed," writes Mr. Bennett, "that the tare will be so low as 10 per cent. The sample roots weighed at the factory as trial weights are scrubbed as clean as parsnips are scrubbed in the kitchen before boiling; their side rootlets are snipped off, for they may hold dirt; and the heads are perfectly trimmed. However from £6 to £7 an acre. In more recent speeches, this untiring advocate of beet growing seems to have put the amount at from £4 to £6. Mr. Courthope stands by the higher estimate. "On any decent land which will grow a good crop of mangels," he says, "a grower ought to make a profit of at least £6 to £7 an acre, in addition to other advantages in the shape of bonus, free lime, and cheap cattle food."* "Assuming that at least 17s. 6d. a ton be

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clean a man may market his roots, he must lose at least 4 per cent. of weight under such a system of taking a sample."

CONTINENTAL AND ENGLISH TONS.—"It must always be borne in mind," says the same correspondent, "that an English ton weighs about 80lb. more than the 20 centners (or double centners) that go to make up a foreign ton. In dealing with large quantities, this works out at nearly 4 per cent., quite a big difference." *See* Appendix.

* EXTRAVAGANT ESTIMATES. — A Continental correspondent writes: "I cannot think that even the best managed land of the very best quality ever did this in a single instance. It is quite easy for a mistake in calculation to happen, and this must have occurred in this case." Mr. Courthope's speech is reported in the *Tunbridge Wells Advertiser*, August 26, 1910.

There have been higher estimates. The following appeared in the *Birmingham Gazette*, March 3, 1911, under the heading, "Sugar Beet Growing: Facts and Figures for Farmers": "At the annual dinner of the Birmingham and District Mineral Water Manufacturers and Bottlers' Association, Limited, Mr. P. W. J. Mackenzie said he was associated with Mr. Stein, the sugar expert, in stimulating interest in the new industry. The cost to the farmer per acre was £9 15s., including rent, labour, manure, and delivery to factory. Each acre should produce 17 to 20 tons of sugar beet. The farmer could sell that at £1 per ton, and his profit could be with safety set down at £7 5s. per acre. But if the leaves and slices received back from the factory for feeding his cattle—valued at £1 5s. per ton—were added, there would be a net profit of £9 per acre. Experiments had shown that they could get a yield of 17·65 per cent. of saccharine matter out of beet, and in some cases as much as 20 per cent."

the minimum net price for roots," writes Mr. J. Saxon Mills, "the farmer should get a profit of at least £6 per acre, and this ought to be *considerably and easily increased*."* Mr. Stein, like Mr. Courthope, produces a balance of from £6 to £7, but in order to do it he has to credit the lime, beet pulp and leaves and tops to the farmer at £3! His cash profit is therefore £3 10s. Mr. Cohen says "at least £5 an acre," plus leaves and top.† If we deduct £2 for "advantages" from the estimate of Lord Denbigh—call it £5—Lord Denbigh's figure would be £3.

Obviously beet growing at £6 to £7, or even—casting aside the £3 worth of "advantages"—£3 10s. 6d. an acre would be a desirable thing, and, at £3 only, quite attractive. How do such figures bear examination?

Mr. Cheney's 14 tons an acre, raised in 1906 (*vide* Chapter XIII.), had the exceptional sugar percentage of 19·4, and would, therefore, had they come under, say, the East Sussex contract, have been worth 22s. per ton at the factory. So the account seems to stand:

	£	s.	d.
14 tons at 22s.	15	8	0
Leaves and tops, say 3 tons at 5s. (Mr. Cheney's estimate)	0	15	0
	16	3	0
Less expenditure, plus £1 for carting	9	5	0
	£6	18	0

This would seem to touch Mr. Courthorpe's figure if it were not that (1) the sugar percentage of the beet

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[*] *Nineteenth Century and After*, May, 1911.

[†] For export: 15 tons at 18s. 6d. delivered—Profit, £4 17s. 6d.
For factory: 15 tons at 21s. 6d. delivered—Profit, £7 2s. 6d.
Production to cost £9.

Sugar Alps at the Hollandia Factory
The pile is about thrice a man's height

grown for the Hollandia Company in England was only 17·8 and in Holland only 17·3, and 19·2 may, therefore, possibly have been a mistake of some sort; (2) that the 14 tons are not stated to be washed weights, and if they were not washed weights they were certainly not 14 tons!

Mr. Stein, whose expenditure was £9 19s. 6d., shows his profit as follows:

	£	s.	d.
15 tons of roots at 18s. per ton*	13	10	0
Value 5 tons leaves and heads	1	5	0
Value 3 tons beet slices 20 per cent. of quantity delivered	1	10	0
Saturation lime (from factory free)	0	5	0
	16	10	0
Cost of crop	9	19	6
Profit per acre	£6	10	6

It seems only necessary to put alongside this estimated profit the statement of one of the warmest supporters of a beet sugar industry, Mr. Martineau, who, after years of study of the subject, and after estimating expenditure at "a shade under £9—and part of this ought to be debited to next crop"—does not believe that there is a profit of more than £3, or that German farmers do so well as that. "Even £3 is high," says a Continental correspondent, "if this is meant to be cash received." It is not, as will be seen later on.

Essex Experience.—That the growers of the experimental crops in East Anglia in 1910 lost money or failed to make any is certain. A man in Essex, who was supposed to have one of the best crops grown in the county, spent £122 on 16 acres, and received only £65. His actual loss he considered to be more than the £57 shown by these figures. The loss sustained by Mr. Strutt is stated on page 145. Mr. J. M. Welch, the details of whose expenditure, £10 18s. per acre on 3½ acres, is given on page 144, writes to me:

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* "*To be on the safe side* he considered that he could take the average production at 16 or 17 tons."—Mr. Stein, *Western Mercury*, March 27, 1911.

> My crop, after deduction for dirt, was barely seven tons per acre, and the price paid 17s. per ton on rail [say £6]. The land on which the crop was grown was a fair sample of the Essex clay soil, and might be described as heavy.
>
> It would not, in my opinion, be possible to grow beet for a smaller outlay than mine: but I think in an average season, with the knowledge we now possess, the average crop should be about ten tons per acre.
>
> The land requires to be very deeply ploughed for a good crop; last season my land was not ploughed deep enough. I should not be willing to grow beet again for less than twenty-five shillings per ton f.o.r.
>
> One great objection to growing beet is the amount of labour required to raise and cart it at a very busy period of the year, with no compensation in the cash return. I grew last year about six acres of potatoes at about the same cost per acre as the beet, from which the return was about £14 10s. per acre as against £6 from the beet, and both mangels and swedes, or white turnips, which would be grown in the same rotation as beet, give quite as large a return as the beet would at 25s. per ton. So you will see there is no inducement for farmers to take it up at 17s.
>
> On lighter soils in other counties probably the result might be better, but I am quite convinced that in Essex we are not likely to have sugar-beet growing on a large scale.

Norfolk.—Mr. Rider Haggard lost £14 on two acres. He has explained matters thus:

> If he were to go further, and took the price he found being paid in the island of Falster, Denmark, namely, £1 3s. 6d. a ton,

there would, according to his calculations, bearing in mind that no refuse was returned, still be a loss.*

Mr. Sawyer has written of his Norfolk experiences:

"The price was 17s. 6d. per ton of 21 cwt. (allowance of 1 cwt. for mould attached), free on quay for clean roots, the seed being supplied free. This certainly seemed at first sight a fair offer, and no doubt was all the foreign manufacturer could afford to offer, as with his expenses of shipping, commission, and sundries, the roots cost him some 27s. 6d. per ton on his side. Then the farmers had the rail charges to pay, averaging about 2s. 6d. to 3s. per ton, and all roots had to be lifted, topped, and carted to the station at short notice at a very busy time, just when all hands are wanted for cleaning the land and wheat sowing. Being a bulky crop the carting was a slow job, about 2¼ tons going to a waggon load, and unless the distance to the station was very short, not many could make more than two journeys per day. As beet certainly does not yield at the most more than half the weight of an average mangel crop, there did not seem to be any financial gain at all, and many found themselves out of pocket over the transaction."

An Agent's View.—But in all the adverse conditions in which the East Anglian crops were grown it would have been surprising had there been a profit. Mr. Petitpierre, the agent of the Hollandia Company, writes:

"I have been fortunate enough to obtain proper figures from five farmers who grew beet over an area of 35 acres. The average cost price comes to £9 18s. 9d., or practically £10 per acre, including rent, taxes, cost of raising and carting the beets to the point of delivery.† The crop raised ranged between five tons and fourteen tons of cleaned roots per acre, making an average of ten tons per acre. As the price paid was 17s. per ton, it would appear at first glance that a loss of 30s. per acre had been suffered by the growers; but, on the other hand, it must be remembered that with sugar beet the value of the tops and leaves left on the field is equivalent to approximately 35s. per acre.* It may therefore be stated that beet growing in England is a paying crop to any farmer who grows more than ten tons per acre, and this minimum has easily been exceeded already by some of those who were willing to give beet a chance."

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* "To send the refuse off the farms is sending one country away in small quantities to another," writes a correspondent.

† I have been unable to obtain the details of these figures.

At an earlier date Mr. Petitpierre had assured me that at 17s. per ton f.o.b.—this is by no means the same thing as f.o.r.—a twelve tons crop on light land would not involve the farmer in any loss, and he had the value of the tops and leaves.

Anglo-German Estimates.—The Essex farmers grumbled at 17s. and the Norfolk ones at 17s. 6d. The following estimated revenue from an acre of beet is based on a payment of 18s. 4d. per ton. The statement is by Mr. Schobloch, a Bohemian agriculturist farming in England, the details of whose estimate of expenditure (£13 14s. 10d.) have been already quoted (p. 158). (Mr. Schobloch took his agricultural degree at Halle, which is in a famous Prussian beet district, and has also studied beet growing in Austria.) He is careful to note that "a crop of 14 tons per acre is exceedingly good, and exceeds by 2½ tons the average in Germany†; beet root growing should, therefore, be limited to the best soils."

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* A Continental's reader's comment: "Too high. These statements damage the prospects of an industry."

† German Crops.—"The average crop in Germany for the last ten years has been calculated at 300 quintals to the equivalent in English measures of 2 acres 1 rood 35 perches, which quantity is equal to nearly 11½ tons per acre. Here I see crops of 17 tons are anticipated (or the equivalent of 425 quintals per 2 acres 1 rood 35 perches), but I do not think it is likely that the average would be as high as that."—A. Schobloch, in the *Estate Magazine*.

H.M. Chargé d'Affaires says the highest yield in Gross Umstadt. Hesse, in 1910, was about 18 tons and the lowest 10 tons. The Hesse average was 13 tons.

ESTIMATED REVENUE.

Per acre.	£	s.	d.
14 tons of beetroot at 18s. 4d. per ton	12	16	8
4 tons of leaves at 5s. 10d. per ton (feeding value equals 9 for 77 clover hay)	1	3	4
6 tons of slices, with 30 per cent. loss for ensilage, returned from factory free of charge, to be given at a rate of five per cent. of live weight of cattle per day at 5s. a ton (feeding value 10 against 77 compared with clover hay) about ...	1	1	0
Unexhausted manures—quarter of cost, approximately	1	4	8
	16	5	8
Subtract expenses ...	13	14	10
NET PROFIT	£2	10	10

Mr. Schobloch, in an explanatory letter to me, says:

> I am fully aware of the fact that the price of 11d. per cwt. is very low indeed. I did not want to give a price that cannot be obtained with absolute certainty, and so might give rise to disappointment. As yet, nobody can with any accuracy foretell what prices are going to be when sugar beet is grown in wider districts of England, and there is much scope for supposition. I have taken into consideration that to start a new industry some encouragement must be given to diminish the risk. Besides, the price mentioned is understood as at farm, and as my balance sheet must be applicable to less favourably situated parts of the country also, I have put all the figures low. Farmers will find no difficulty in adapting them to the conditions of their particular districts.
>
> It is likewise understood that the slices are returned and delivered free of charge at the station, and that no reduction is made for loss of weight at factory, the roots being roughly cleaned only, the cart loads passing a weighbridge.

No English factory has yet offered to pay carriage on slices.

Attached to the Maidstone Report are some calculations based on a suitable rotation for English corn farms: beet, wheat, seeds, oats, or barley. The delegates say that "whereas the root crop in the four-course rotation entails a loss in preparation for the succeeding crops, the beetroot year in the other rotation, while answering exactly the same purpose as a feeding crop, shows at the same time the best profit of the series":

FIRST YEAR.

BEETROOT.

Outlay.	£	s.	d.
Dung, labour only	1	5	0
Once ploughed, four horses	0	18	0
Twice balked, three horses	0	12	0
Four times harrowed, two horses	0	3	4
Twice rolled	0	1	8
Seeds, 16lb.	0	8	0
Drilled	0	2	6
Artificials	1	0	0
Hoeing and setting out	1	10	0
Lifting	1	10	0
Carting three miles	1	2	6
Rent and rates	1	15	0
Bills, &c.	0	5	0
	£10	13	0

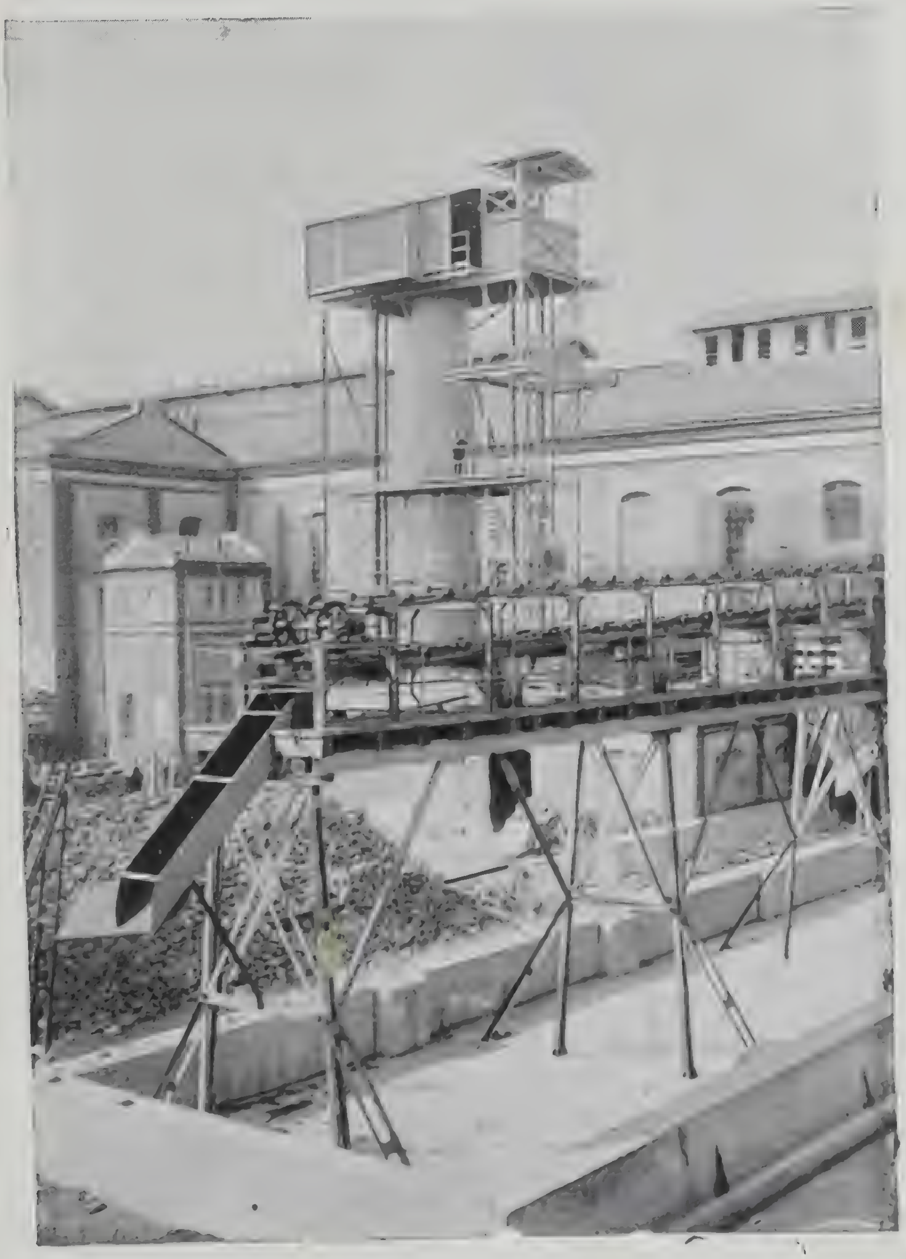
Result.	£	s.	d.
15 tons beet at £1	15	0	0
7½ tons slices returned free from the factory at 5s.	1	17	6
Tops and leaves	1	0	0
	£17	17	6
	10	13	0
Profit	£7	4	6

SWEDES OR TURNIPS.

Outlay.	£	s.	d.
Dung, labour only	1	5	0
Twice ploughed, three horses	1	6	0
Cultivated	0	6	0
Four times harrowed	0	3	4
Twice rolled	0	1	8
Seed	0	2	0
Drilled	0	2	6
Artificials	1	10	0
Hoeing, hand	0	15	0
Hoeing, horse	0	5	0
Rent and rates	1	15	0
Bills, &c.	0	5	0
	£7	16	6

Result.

Feed for 250 sheep one week at 6s. per score per week = £3 15s., representing a loss of £4 1s. 6*d*.



[illegible] FOR DISCHARGING WET SLICES (LEOPOLDSDORF)

Lime-burning tower behind

SECOND YEAR BEETROOT ROTATION.

(Fourth Year Norfolk Rotation.)

WHEAT.

Outlay.	£	s.	d.	Result.	£	s.	d.
Once ploughed, two horses	0	12	0	Five qrs. wheat, at 30s.	7	10	0
Seeds, 2½ bushels, 5s	0	12	6	Straw, feed price	1	0	0
Sowing	0	1	0		£8	10	0
Twice harrowed	0	1	8		5	4	8
Rolled	0	0	10				
Harvesting, stacking, and thatching	1	5	0				
Rent and rates	1	15	0				
Bills, &c.	0	5	0				
Threshing, 5 qrs., at 2s. 4d.	0	11	8				
	£5	4	8	Profit	£3	5	4

In the Norfolk rotation it is usual to dung for wheat. It is assumed in these calculations that the whole of the straw is converted into dung. Labour only is reckoned on the dung, and for convenience it is assumed that all the dung is used on the first crop of the rotation.

THIRD YEAR.

SEEDS.

Outlay.	£	s.	d.	Result.	£	s.	d.
Seed and season	0	15	0	1½ tons first cut, 80s.	6	0	0
Haying, two crops	1	10	0	½ ton second cut, 60s.	1	10	0
Rent and rates	1	15	0		£7	10	0
					4	0	0
	£4	0	0	Profit	£3	10	0

SECOND YEAR, OLD ROTATION.

(Fourth Year Beetroot Rotation.)

OATS.

Outlay.	£	s.	d.	Result.	£	s.	d.
Cultivation and seed ...	1	10	0	Eight qrs., at 17s. 6d.	7	0	0
Harvesting	1	5	0	Straw, feed price ...	1	0	0
Rent and rates	1	15	0				
Threshing	0	12	0		£8	0	0
Bills, &c.	0	5	0		5	7	0
	£5	7	0	Profit... ...	£2	13	0

SUMMARY.

BEET ROTATION.	£	s.	d.	FOUR-COURSE ROTATION.	£	s.	d.
Beet, profit	7	4	6	Roots, loss	4	1	6
Wheat ,, ...	3	5	9				
Seeds ,, ...	3	10	0	Oats, profit	2	13	0
Oats ,, ...	2	13	0	Seeds ,, ...	3	10	0
				Wheat ,, ...	3	5	4
4)	16	12	10				
					£9	8	4
					4	1	6
				4)	5	6	10
	£4	3	2½		£1	6	8½

This calculation shows an annual profit per acre in favour of beetroot of no less than £2 16s. 6d.

But the promoters of no English factory have as yet offered as much as £1 per ton at three miles from the farms or f.o.r., and there is as yet no authority for an English average crop of 15 tons, the receipts on which these calculations are based! I append a note by Mr. A. O. T. Bennett:

The feeding value of swedes is put at the low figure of £3 15s. an acre. I do not think that the majority of growers would be satisfied with this sum.

No allowance is credited for leaves and the manurial value left behind by feeding the crop off with sheep, which I consider is unfair to this crop. Then swedes are debited with £1 10s. for artificials, and sugar beet with only £1, whereas every one who has had practical experience of growing sugar beet knows that it requires a large amount to make them grow satisfactorily. I put the value of artificials at £2 15s., and this is rather under than above the mark.

I do not doubt that 15 tons of sugar beet can be grown in England, but if these heavy crops would be welcome at the factory is quite another question. Of one thing I am certain, and that is, that an average crop of 12½ tons of beet containing 16 per cent. to 18 per cent. sugar might be looked upon as satisfactory.

Mr. Bennett's Westphalian friend's expenditure worked out, it will be remembered, at £9 17s. 7d. (page 152). His receipts, reckoning 10½ tons as average, with an average price of 20s. 6d. per ton for roots are:

	£	s.	d.
Roots	10	15	3
50 per cent.* of pulp is returned from factory, which equals 5½ tons at 6s. 8d. per ton ...	1	15	0
Value of leaves (more if cows are kept) about ...	0	15	0
Value of lime returned from factory	0	1	3
	£13	6	6

Less £9 17s. 7d., this is £3 8s. 11d profit, or in cash, deducting £2 11s. 3d., value of slices, leaves and tops, and lime, 17s. 8d. per acre.

A German farmer (Hesse) whose figures have reached me receives 19s. 6d. per ton for roots sent to the factory up to November 15, and 21s. 9d. afterwards. (The factory is not bound to take a heavier weight than 13¾ tons an acre from him, and his roots may be refused if their sugar percentage is below 12 per cent.) He gets 40 per cent. of wet slices back, or 4 per cent. of dry slices. The wet slices he pits. He values them at 3s. a cwt. As the pressure of earth squeezes out the water, what he really feeds to his stock is more like 15 per cent. than 40 per cent. On a 14 tons crop the return is £2 14s. If he gets 4 per cent. of dried slices from the factory that would mean 80lb. to the ton of beets, or 12cwt. 20lb. to the acre. The value is put at 5s. a cwt. But as 1s. 6d. is paid for drying, the net value is only 3s. 6d. Call it 43s. per acre. The wet slices may not really be more valuable. It is guess work how much weight they lose. But the cost of earthing them up and digging them out again would make up for the apparent extra value of 11s. This correspondent says a crop of 14 tons costs, less rent and rates, 10s. a ton to produce, a 12-ton crop 11s. 7d., and an 11-ton crop 12s. 8d. His average is 12 tons. Cartage is paid by the factory up to 15 miles. He does not get as much for his beets as factory shareholders. They also get 50 per cent. of wet slices or 5 per cent. of dry. But then he is free to grow as much or as little beet as he likes.

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* This man had the advantage of being a factory shareholder.

Another correspondent, on the north-western side of the Harz, grows from 9½ to 11 tons an acre, with a sugar percentage of 14 per cent. to 15 per cent., and gets 20s. a ton for beet which costs £8 5s. an acre to produce independent of rent, rates, and transportation.

A fourth German farmer, who puts his sugar percentage at from 16 per cent. to 18 per cent. and may have his roots rejected if they do not contain 15 per cent., gets from 20s. to 21s. 6d. per ton, and 50 per cent. wet or 5 per cent. dry slices. The slices from a 10½ tons crop he values at from £1 4s. 9½d. to £1 10s. 6d., according to the year and demand. His return in money and kind, *i.e.* slices, tops, &c., he places at £13 8s., leaving a net profit of £3 7s. 9d. With his rent to deduct from this amount, the profit is, as be remarks, "not huge."

"One thing seems certain," writes Mr. Bennett, "that the hard cash received for roots is not very high; I should say about 25s. at the outside per acre."

Here may be suitably quoted, perhaps, the words of an East Anglian farmer, who, after losing money to a considerable amount on his 1910 beet crop, said that, as to profit, he had "never taken any stock in the £6 to £7 an acre fable, and would be glad of £1 an acre:"

> There are plenty of farmers this year who would be glad of a clear £1 for their wheat. I should be glad to fill up my farm with certainties at £1 an acre.

Railway Carriage.—In order to get a notion of what delivery at the factory involves in the way of carriage, I may mention that a list of the Great Eastern's special beet railway rates to Maldon now before me shows a charge of 2s. 9d. for 30 miles, 2s. 4d. for 20 miles, and 1s. 6d. for 10 miles. It would appear, therefore, that 2s. is not too high an average grower's rate. It is suggested to me that "delivery to the factory will be mostly by road from the neighbouring farms"; but the cost of waggons and horses sent 10 miles is a good deal. Can more than two and a half tons be supposed to go in a waggon?* In calculating a railway rate something must be put down for dirt knocked off the beets in their journey on the line. If we call the whole railway rate 2s. 6d. a ton we shall probably not be far wrong. It may be noted, however, that while Mr. Stein has credited beets in his farmer's balance sheet at 18s. a ton, the Kidderminster factory evidently proposes to pay only 20s. delivered, which does not allow the farmer 2s. 6d. for carriage. Mr. Cohen's 21s. 6d. at factory, or on rail, less carriage, is more generous.

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* Mr. Sawyer writes: "In the case of export the delivery has to be very quick; possibly in the case of a factory in this country more time could be allowed. It is a bulky crop, and a farmer must be very well horsed, and able to obtain extra labour, or he will find it very slow work delivering even an acre or two of sugar beet, besides getting behind on the farm, foul stubbles neglected, wheat sown late, mangel frozen, and his bullocks not boxed at the proper time."

The Price Per Ton Required.—"I still believe," writes the Hon. Edward Strutt to me, "that, if properly worked, beet might be made a very profitable industry in England, but £1 per ton is the lowest which the farmer could afford to take within, say, three miles of his field." Mr. Sawyer also asks for £1. This is, of course, a price free on rail that has as yet only been offered delivered at the factory. If the price is to be 20s. f.o.r. it means 22s. 6d. at the factory. "If the Germans get from 20s. to 22s. f.o.r.," writes Mr. Martineau, "it is quite right to urge that 17s. 6d. is too low." (If 1 cwt. of soil is tipped into the railway waggons with each ton of beets, our farmers receive only 17s. 4½d.) Mr. Cohen's 21s. 6d. would mean that no farmers who were within five or six miles of the factory would obtain less than 20s.

What Do German Farmers Get?—How much is really paid to the German farmers for their beet? Let me attempt a table:

All Prices for 1910 except where mentioned.

(German factories are presumably at no great distance from the farms.)

Mr. Bennett's farmer in Westphalia "Carted to factory or station." Average price (plus 50 per cent. of slices)	20s.	6d.
Hesse farmer averages 20s. 9d. (plus 40 per cent. wet and 4 per cent. dry slices)	20s.	9d.
Farmer, N. W. Harz	20s.	0d.
Fourth German farmer 20s. 9d. (plus 50 per cent. wet and 5 per cent. dry slices)...	20s.	9d

Maidstone delegates. 21s. delivered "at two factories near Magdeburg" (plus 50 per cent. of slices) 20s. in their own balance sheet. Say	20s.	6d.
Gross-Umstadt factory, Hesse. "Co-operative members receive 19s. 4d. a ton and 40 per cent. of the weight of the beet in fresh beet clippings free for fodder, regardless of the amount of sugar. Additional payment will probably be made based on the amount of sugar above 14 per cent., so that the farmers will receive about £1 2s. a ton for 16·76 per cent. beet. The farmer's receipts work out at about £14 9s. per acre, in addition to the value of the beet clippings and the green tops for fodder. Farmers who are not co-operative members receive about £1 1s. 4d. per ton of clean beet regardless of sugar content, but do not get free clippings"	21s.	4d.
Four factories in Hesse. Average. No details. ...	19s.	10d.
Kruschwitz factory, 21s. 1d. plus bonus £8669 (1908-9)	21s.	1d.
Various Prussian factories (*vide* below). In addition to some freight, bonuses, &c.	22s.	0d.

The twenty-nine factories in Holland, ranging from 17s. in 1906 to a maximum of 22s. in 1910, "delivered to the nearest canal, or railway station." Say	19s.	6d.
Dr. Van Ryn (*see* Chapter XV.) gives figures 19s. 2d. to 21s. 10d., say	20s.	10d.

A correspondent in Germany writes as I extract these figures: "19s. is low; 23s. is high here." There is this further piece of evidence:

All along the Rhine from Mainz to Worms (writes H.M. Chargé d'Affaires at Darmstadt in 1910) the Dutch sugar factories have been buying beet direct from the farmers, and have outbid the local factories by about 4s. a ton; high prices are also expected next season owing to this competition.

Then a friend sends me the following cuttings from a Continental sugar trade paper:

> In West Prussia, a sugar factory is offering 0·90 M. per 50 kilos (18s. a ton), but if profits exceed 60,000 M. (£3000) it will pay 1·10 M. (22s. a ton) and divide any surplus between factory and growers. It also pays 15pfg. freight, and for November delivery 5pfg. more, and it gives back 35 per cent. of pulp.
>
> Other factories are offering 0·95 M., 1·30 M., 0·95 M. to 1·10 M. [an average of more than 22s. a ton] ,some of them seed free, freight partly borne by the factory, and 40 to 50 per cent. of the weight of the beets allowed in pulp.

Yet, one may read in another paragraph in the same journal:

> The Growers' Union claims that in view of the continually increasing cost of production there has been no profit for several years, and advise a decrease in sowings.

What is truth?

Setting aside the question of profit for the moment, the foregoing figures certainly seem to point to the fact of many German growers receiving in cash something more than 20s. per ton for beets delivered at the factory—the highest offer by any project in England before the advent of Mr. Cohen.

"We ought to get here," writes an English farmer who knows Germany, "20s. a ton, or rather 21s., to compare with German ton."

The Farmers' Dividends.—The correct estimation of the value of the total sum received by Continental farmers in respect of their beet crops is complicated not only by the varying distances which the farmers have to cart their beets to the factory, station, or canal or riverside, and by the varying cost of labour (of which we are imperfectly informed, but no doubt dependent on the degree of nearness to a town), but by (1) the varying arrangements as to allowances of seed, pulp, and part freight, and (2) the different value of the bonuses the farmers receive from the factories and of the shares they hold in them.

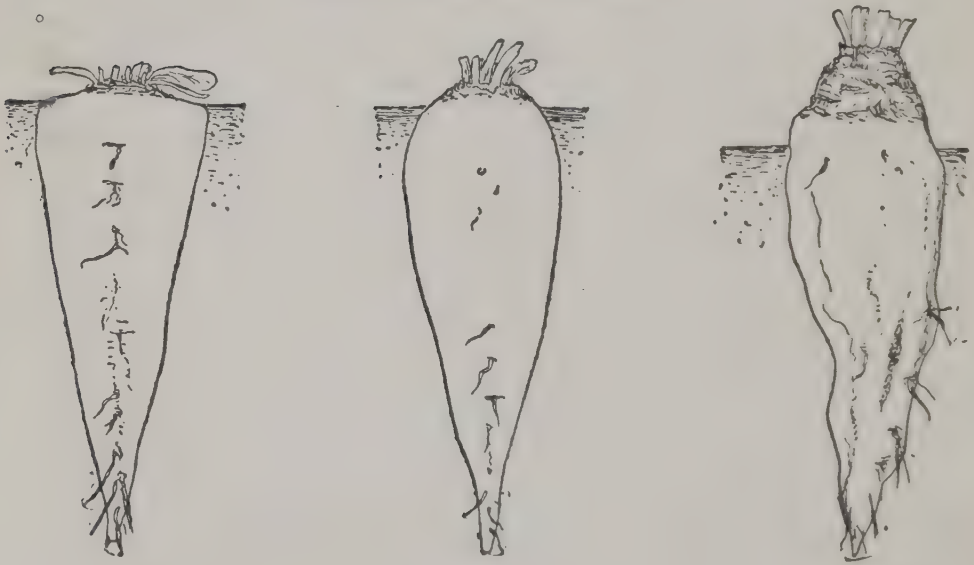
Some light is thrown in the next chapter on the value of the allowances of pulp and lime. As to the dividend which the farmers get as shareholders in the factories, practically all the German factories are co-operative, that is, they belong to the farmers.

They are not, as I explained in the *Field*, co-operative institutions according to the strict tenets of our Agricultural Organisation Society. They are, in reality, joint stock enterprises, the capital of which is held by farmers. As a German expert said to me, "What does it matter if German farmers get only 17s. a ton for their beets if they have their profits as factory proprietors? The masters of the factory managers are the farmers." At the beginning, of course, a large proportion of the money is found by the banks, which do business in a more pushful and commercial way than our older fashioned banking companies care for; but, as the funds advanced by the banks are gradually repaid out of profits, the factories come in due season almost wholly into the farmers' hands.

I am glad to find Mr. Rider Haggard supporting my suggestion that the ideal way of starting a beet sugar factory in this country would be by co-operative enterprise among farmers. It may be, however, that to wait for co-operative agricultural effort is to delay English beet sugar making indefinitely. Nevertheless, beet growing must be largely the concern of landowners and large farmers. Agriculturists in a considerable way of business have, an opportunity, therefore, by subscribing capital to factories, of putting themselves in the way of receiving dividends, as well as so much per ton for the beet they grow.

A Cash Transaction.—In regard to what is paid for beet, apart from allowances, bonuses, and dividends, it should be borne in mind that the money is paid cash down, not through stock—the feeding of which may or may not return a profit; is, under the contract system which the factories propose, certain in amount for five years; and is receivable within a week or so of the delivery of the roots. The beets are not sold, like corn and beasts, on a competitive market.

Some Varieties of Beet.



Vilmorin's Improved

Knauer's Imperial.

White Silesian Beet on Mangel.

CHAPTER XVII

THE RETURN IN KIND

By-Products of Crop and Factory.—Among the advantages of beet culture which are not expressed in the price paid per ton, is the fact that the remarkably luxuriant leaves of the beet and a good sized top—all that is growing out of the ground or, as they say in America, all above the sun line—are left in the field as manure or may be fed to cattle.

As a matter of fact, if a sufficient quantity of the slices, the molasses, and the free saturation lime were brought back from the factory, nothing at all would be taken from the farm but sugar, water, and, say, a certain amount of potash. If, however, the factory produces white sugar only, as was proposed at Maldon, the potash salts would be found in a by-product, the molasses. As to the sugar, it may be popularly explained as a gift of the sunshine working in co-operation with water and the carbonic acid of the air. Therefore, if the farmer only obtains enough by-products, or, as he would do in practice, makes up the deficiency by suitable manuring, his farm is in no sense a loser at all, but may make a net gain on the lime! Beet is plainly, therefore, a crop which need not impoverish the land. It might rather be described, having regard to the tons of leaves and tops, as an enriching crop, a cleaning crop, and a crop which gets the land into that more and more deeply worked state which is the ideal of every worker of the soil.

Leaves and Tops.—The precise value of the leaves and tops is thus discussed by Dr. C. O. Townsend in the "Year Book of the American Department of Agriculture":

> Although the sugar is made in the leaves, only a small percentage remains in them, as it is constantly passing into the root, where it is stored. The crown also contains a comparatively small quantity of sugar, while both leaves and crowns contain a comparatively high percentage of mineral matter or ash. The percentage of ash in the leaves is usually about three times as great as the percentage in the untopped beet, while the percentage of ash in the crown is more than six times as great as the percentage in the whole beet.
>
> The leaves and crowns may be utilised either as a fertiliser or as a stock food. As a fertiliser they may be ploughed under in the autumn while still green or they may remain on the ground and be ploughed under in the spring, after more or less decomposition has taken place, or when given as food to stock they may enter into and form a part of the stable manure, and in this manner be returned to the soil. If left in the field and ploughed under they will add a small amount of humus to the soil and a comparatively large amount of mineral matter. They should therefore be spread over the ground as uniformly as possible if they are to be ploughed under.
>
> The weight of leaves and crowns produced per acre varies greatly in different parts of the country, as well as from season to season, depending upon soil and climatic conditions. Crowns and leaves together give a total average yield of 244lb. of mineral matter per acre. This mineral matter consists for the most part of potash, soda, lime, magnesia, chlorine, sulphuric acid, silica, and phosphoric acid, which are mainly necessary plant foods, so that the value of this by-product as a fertiliser should not be overlooked.
>
> If the leaves and crowns are to be given to stock they may be utilised in the fresh state, dried, or siloed. One of the most satisfactory methods of feeding with beet leaves and tops is to dry them. This requires extra labour, and if they are artificially dried special machinery is required, which means additional cost. Tops when fresh contain from 83 to 90 per cent. of water, and when dried from 10 to 12

WET BEET SLICES ON THE RAILWAY IN FRANCE

FRENCH PEASANTS WHO HAVE BROUGHT BEETS TO THE FACTORY, WAITING AT THE SHOOT FOR A LOAD OF WET SLICES per cent.—that is, in drying there is a loss of about 75 per cent. of the original weight of the material, so that the average yield of dried material per acre is about one ton, which is considered equal in feeding value to the same quantity of first-class hay.

In some localities, especially in dairy sections, beet tops are siloed with other material for winter and early spring feeding. These silos are filled with alternate layers of beet leaves and some dry material, like straw, which will take up the excess moisture from the leaves. The layers of leaves are, or should be, sprinkled with salt, using about 6 or 8 pounds per ton of leaves. This mixture, if properly siloed, will keep for several years and is considered very satisfactory by dairymen.

Mr. A. D. Hall has expressed the opinion (*Journal of the Board of Agriculture*, 1905) that the leaves "do not form a very satisfactory food for stock, and are apt to induce scour." "They are best ploughed in," he says; "if fed they must be used with caution and in conjunction with a fair proportion of dry food."

Two East Anglian farmers have already reckoned the value of the leaves and tops as equal to that of raising the beet crop. The Hollandia Company informs me that the value is put by Dutch farmers at anything between 17s. and 34s. an acre. A Dutch correspondent writes to me: "Cattle must not be given too much beet leaves without dry food or the milk will have a miserable taste." A Swedish farmer expresses the same opinion.

On some parts of the Continent, pigs and sheep are turned out to consume all leaves and tops and unharvested roots. (This method, an American writer points out, may be a wasteful one.) Mr. Cohen suggests that:

> These leaves, if properly handled, will serve the whole winter as a green fodder, and are used as such in all the beet districts of the Continent. It is a wholesome fodder, and well liked by cattle and sheep. The value of the fodder, calculated upon its feeding capacity, may be taken to represent a minimum of £1 per acre.

Geschwind values the leaves and tops at 14s. 7d. an acre. Dr. Townsend's estimate is 25s. per acre, or 6s. 3d. per ton fresh; 25s. dried. It is evident, he says, that the heads of the beets "have not received the attention due to them as a fertiliser or as a stock food."

Summarising my authorities and those quoted in Chapter XVI., we have the following:

	£	s.	d.
A German farmer, 13s. 9d. to 16s. 6d., say ...	0	15	1
Geschwind	0	14	7
Townsend	1	5	0
Cohen	1	0	0
Hollandia Company (average)	1	5	3
Maidstone Delegates	1	0	0
Mr. Bennett's German farmer, 15s.; "more if cows are kept." Say	1	0	0
Mr. Schobloch (4 tons at 5s. 10d.)	1	3	4
Mr. Stein (5 tons)	1	5	0
Mr. Cheney (3 tons at 5s.)	0	15	0
Average value per acre	£1	0	3

Obviously the value wholly depends on the weight of the crop of beets.

Weight of Leaves and Tops per Acre.—There is some excuse for a difference of opinion as to what the weight of these leaves and tops per acre is likely to be. Hall has suggested that it might be one-fifth of the crop. An experiment made by Messrs. Hasler and Clapham, Dunmow, showed, I am informed, that forty beet weighed 56lb. ready for the factory, and that their leaves and tops weighed 29lb,, or 38·6 per cent. The agent at Maldon for the Hollandia factory writes to me:

> Though with ordinary mangels farmers may get an average yield of 20 tons per acre, the average weight of tops left in the field does not exceed 3 tons; whereas, with sugar beet, taking an average yield

of 15 tons, the weight of tops per acre will be anything between 17 and 20 tons. These tops can be used as fodder, but if left on the field as manure this enormous weight should be taken account of, the more so that there is no cartage on such manure.

I have never heard of such a tonnage of tops before. Dr. Townsend says:

> An average of 4 tons of tops per acre is a conservative estimate: 1 ton per acre is crowns, 3 tons per acre are leaves. The crowns contain about 5·6 per cent. of mineral matter or ash, which is equal to about 112lb. per acre, while the leaves contain about 2·2 per cent. of ash, yielding for the 6000lb. about 132lb. of mineral matter per acre.

Mr. W. E. Sawyer sends me the following table of Norfolk weights on October 20, 1910:

	Tons	cwt.	qrs.	Tons	cwt.	qrs.
With leaves	29	10	0	32	11	0
Without ,,	11	11	1	14	1	0
Leaves	17	18	3	18	10	0

Results, October 28-29, from roots analysed, and no doubt a little withered before weighing in London:

	lb.	oz.	lb.	oz.
Average weight per root with leaves	1	9	2	9
,, ,, without ,,	0	15	1	4

The tables of Mette and of the Zuckerfabrik Klein-Wanzleben, in the Appendix, indicate that, while to the end of August, or even a fortnight into September, the leaves and tops are heavier than the roots, the weight of the roots later on exceeds the weight of the leaves and tops. This is final.

Their Preservation.—I have been favoured with the following account of German practice:

> They put the tops and leaves in a brick silo or in dug pits and mix the returned slices with them. This is readily eaten, though the

smell is not pleasant—a cross between that of a whale oil factory and sauerkraut! They think that the silage is better for the cattle than when either leaves or pulp are fed fresh.

These leaves are commonly forked up in the fields roughly with a minimum of labour and carted to silos or pits. Then pigs or sheep are turned out to clear up the remainder.

They have also a comparatively recent process of drying leaves and tops on the farm, but as the initial cost is from £3000 to £4000, it is only very large farmers—men growing 200 acres or so beet—who can afford to dry. [Here, side by side, are two analyses of dried beet leaves:—Moisture, 7·4; 9·5. Protein, 9·4; 8·4. Fat, 1·0; 2·3. Non-nitrogenous, 51·9; 50·7. Raw fibre, 12·4; 10·9. Ash, 17·9; 18·2.]

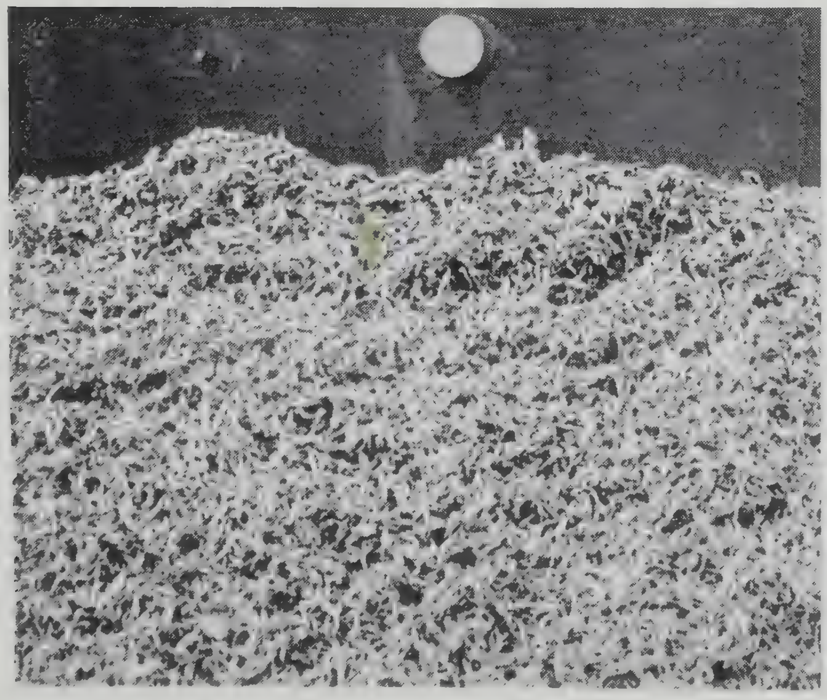
The Terms on which Slices may be Had.—The value of wet and of dry slices and of saturated lime is discussed in the following paragraphs. So far, however, the framers of no English factory proposal seem to have definitely stated on what terms they propose to dispose of wet and dry slices to the farmers who supply them with beet. The Maldon factory evidently meant to sell both sorts of slices; the Kidderminster and East Sussex factories are apparently to give some wet slices away.

The Hollandia Company kindly writes to me:

> There is in Holland no connection between the slices returned to farmers and the acreage. It varies more according to the nature of the farm, whether the farmer keeps cattle or not. [*Vide* Westphalia farmer's estimate, just given.] In some districts in Holland we return no slices. In some districts 30 per cent. of the beets supplied. In other districts 70 per cent. of the beets supplied. Others again 100 per cent. and even more. The slices returned to the farmer are always paid for.

The Magdeburg farmers interviewed by the Maidstone delegates were getting 50 per cent. The quantity sometimes depends on whether a farmer is a shareholder. One of our German farmers quoted, a shareholder, got 50 per cent. wet or 5 per cent. dry; a non-shareholder had 40 per

Kiln for Drying the Slices at the Hollandia Factory



Dried Slices

The coin in the photograph (to show the size of the slices) is a two-shilling piece

cent. wet or 4 per cent. dry. Mr. Schobloch puts down 6 tons of slices returned for 14 tons of roots (nominal).

Wet Slices.—The substance of the beets after they have been sliced and the sugar has been extracted is known as pulp, chop, cossettes, wet slices, or dry slices. For every 1000 tons of beet which go through one factory at which I made enquiry about 700 tons of wet slices and 50 tons of dry slices are annually produced. It will be seen, therefore, that in the case of this particular factory—a Dutch one with a good canal service to the farms—most of the slices were taken away wet, just as in this country brewers' grains are carted.

> Wet pulp (Dr. Townsend says) constitutes about 80 per cent. of the weight of the beets. In the process of extraction the beets lose nearly all their sugar, usually only a fraction of 1 per cent. being left in the residue or pulp. They also lose a large part of the salts taken up in the process of growth, so that the residue after extraction consists of about 90 per cent. of water, from 1·5 to 3·5 per cent. cellulose, a fraction of 1 per cent. each of albuminoids and ash, and about ·5 to 3·33 per cent extractive substances.

The wet slices come from the factory in a condition not unlike wet macaroni. There is a drip from the cart. They can be fed at once mixed with a good deal of dry food, but are usually stored. In Germany, the waggons which take the beets to the factory bring back pulp, and, unless there is a brick or other silo, it is, for economy of labour, stored in the beet field or any other convenient spot. A trench is dug out and the pulp is shot into it, the pile gradually rising into the shape of a mangel clamp. It is earthed over in the same way, and later, from time to time, as the water disappears, fresh earth is piled on. When taken out of the clamp the pulp, if badly preserved, has a strong smell, especially if leaves have been mixed with it. But frequently it has no disagreeable odour.

Experiments in America.—A farmer who takes a ton of beets to the factory and brings back a ton of pulp, the *American Sugar Industry* says, has "really brought back as much feeding value as he has delivered, while the cost is only one-third to one-fifth of what it cost him to raise the beets." Here is an American experiment with "several hundred steers, thin in flesh":

> There was plenty of cheap pasture for grazing in the summer. The object was to carry through the winter with as little outlay as possible until pasture was available. The steers used in the experiment were divided into two lots, as much alike as possible. The first lot was fed a daily ration as follows: Pulp, 55lb.; mixed hay, $8\frac{1}{2}$lb.; shredded corn stover, 4lb.; ground grain, $2\frac{4}{10}$lb. The daily ration of the second lot was: Mixed hay, $11\frac{5}{10}$lb.; shredded corn stover 8lb.; grain $11\frac{1}{2}$lb. It will be noticed that the second lot was only fed grain and ordinary forage, while the first lot was fed with same and in addition sugar beet pulp. The steers receiving pulp in their daily ration made an average daily gain of 684lb. Comparing the amount of food consumed by each pen to produce the net pounds gained, and computing from these data the value of a ton of pulp as an additional succulent food, the test shows that, under the conditions existing, a ton of pulp fed with other factors in the ration took the place of $42\frac{1}{2}$lb. of corn stover, 274lb. of mixed hay and $6\frac{8}{10}$lb. of grain.

A Michigan experiment was held to demonstrate that a ton of the slices would produce 41lb. of beef, live weight.

> The pulp may be used, as it comes from the factory (Dr. Townsend says) or it may be left for some time in the factory, silo, or pit, or the stockman using it may haul it to his farm and pile it in some convenient place for feeding purposes. The layer of the pulp on the surface of the pile—that is, the part exposed to the air—undergoes certain fermentation changes and should be discarded; for this reason the pulp should be kept in piles as large as practicable, since the larger the diameter of the pile—that is, the greater the bulk of material—the smaller the proportionate loss from surface fermentation. Whether it is to be fed in the wet or in the dried condition it should be mixed with other material before feeding.

It is customary to feed the pulp mixed with a given amount of grain or oil cake, together with a quantity of chopped hay, straw, dried beet leaves, or material of a similar nature, the proportion of pulp to other material depending upon the object sought. In some instances the grain or oil cake is omitted and only the pulp and roughage fed. According to good authority, the daily ration should amount to only about 6 to 10 per cent. of the weight of the animal, so that an animal weighing 1000lb. would receive from 60lb. to 100lb. of pulp, to which should be added roughage to the extent of 10 to 15 per cent. of the weight of the pulp and when desired from 2lb. to 5lb. of oil cake or grain per 100lb. of pulp and roughage.

German and Hungarian Experience.—The Maidstone delegates mention the case of a German farmer they met with, who, because he used town dung and kept no stock, and had therefore no use for the pulp, was given in lieu of it an extra 3s. per ton for his beets. It is stated to have been held in the German Courts that beet slices are worth, for beef cattle, 6s. per ton; for working oxen, 5s.; for sheep, 7s.; and for milch cows more than for any other stock.

Mr. Easdale, writing of his Hungarian experience, describes the pulp as one of the best fattening fodders.

It was devoured by practically all cattle in the condition in which it arrived from the factory, or at any rate with the addition of a little chaff or chopped hay. When used for fattening purposes it was mixed with a little chaff or chopped hay and some maize meal. The writer was personally engaged in supervising the fattening of a considerable number of large white longhorn Hungarian oxen by means of this fodder, and it was remarkable to notice the avidity with which most of these animals consumed it, and the rapidity with which they put on flesh.

In 1909, a Government report from The Hague states, wet pulp was sold by the Dutch factories at 4s. 8d. per ton delivered at the factory and 5s. 11d. delivered to the customer. Dr. Townsend suggests that its value as stock food is from 4s. 2d. to 6s. 3d. per ton. The values per acre given by the authorities quoted in Chapter XVI. may be summarised as follows:

	£	s.	d.
Maidstone Delegates (7½ tons returned at 5s.) ...	1	17	6
Mr. Bennett's Westphalian farmer (50 per cent. returned = 5¼ tons at 6s. 8d.)	1	15	0
Mr. Schobloch, (6 tons returned = 5s., less ensilage loss)	1	1	0
Mr. Stein (20 per cent. returned = 3 tons)	1	10	0
Average value per acre	£1	10	10

Mr. Bennett himself, after further correspondence with Germany, is disposed to estimate the value at 5s. per ton.

Dried Slices.—The following analyses of the dried slices are given in parallel columns to show the differences in the composition of various samples:

“Sugar” (Newlands).

Water	12·85
Fat	·64
Albuminoids	7·34
Carbohydrates	56·61
Cellulose (fibre)	16·73
Mineral matter	5·83

Kellner.

Sugar	6 to 7
Nitrogen-free extract......	50·4
Raw protein	4

American Analysis.

Water	8·12
Raw protein	7·8
Nitrogen-free extract ...	50·60
Crude fibre	18·20
Ash	4·8

East Anglia Sugar Company's Brochure.

Water	10
Fatty matter	1
Albumen	7
Farinaceous matter...........	58
Indigestible fibrous matter...	17
Ash	3
Sugar	4

Steffen's Infusion Process.

Water	10
Protein	6·8
Fat	·3
Non-nitrogenous	34·3
Total sugar	33·0
Fibre	11·8
Inorganic matter	3·8

The cash value of the slices is discussed in Chap. XX. and the Appendix. Note in reading the foregoing analyses that in some factories a considerable amount of sugar is left in the slices. Mr. Cohen is quoting Steffen system dried pulp, containing 30 per cent. sugar, at £6 10s. f.o.r. Harwich. It is affirmed that this 30 per cent. is all sugar.

For easy handling and storage the dry slices are preferred to the wet. Incidentally, they do not smell. The cattle do not mind the smell, but it is hard on their attendants!

For cattle the slices are soaked in warm water, of which they absorb five times their weight. They swell out to about thrice their bulk. The Hollandia brochure suggests that cows be given from 7lb to 10lb. a day, pigs from 3lb. to 4lb., and calves 1lb. to 5lb., according to age. Good points about dried slices are that they keep well and that it is easy to ascertain if they are adulterated.

Molasses.—With regard to molasses, they are practically half sugar[*]:

Sugar	49 per cent.	Ash	12 per cent.
Water	20 ,,	Organic matter (non-sugar)	19 ,,

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[*] Molasses as Fertiliser and Stock Food.—"The sugar cannot be separated from the non-sugars by the ordinary methods. [There are German factories for the purpose which adopt elaborate methods.—H. C.] owing to the presence of various salts that have been taken up by the beet from the soil in the process of growth. There are some organic substances which, with the salts, may be classed as non-sugars.

"The presence of a large proportion of non-sugars, especially of mineral salt, makes the waste molasses a valuable fertiliser, but it could not be used economically for this purpose, owing to the great loss of sugar that would result. [Cane molasses is used as a fertiliser. For the most recent experiment, see *International Sugar Journal*, March, 1911.—H. C.]

Beet molasses are used in feeding cattle—a disagreeable flavour prevents kitchen use—by being dissolved in water, the liquid being mixed with dry food. When animals have become accustomed to molasses—it is a gradual process—it is said that they can be fed the following quantities daily "per ton of weight":

Horses	7lb.	Fattened cattle	9lb.
Milch cows	6lb.	Pigs	12lb.

It is stated that in Hanover from 10,000 to 15,000 tons of molasses are used each year as cattle food, while Germany, as a whole, consumes about 200,000 tons, or the equivalent of 33,000,000 gallons.

The following are the comparative figures of an American experiment showing the cost of feeding 23 head of horses one month on crushed barley and hay, and on molasses and hay:

Rolled barley, 4 tons at $30	$120·00
Best barley hay, 10 tons at $12	120·00
	$240·00

"The non-sugars do not prevent the molasses from being used as a stock food, provided too large a quantity is not fed at one time or in one day. Giving molasses to stock has been practised in Europe for 100 years. It may be dried with beet pulp, alfalfa, or other material for feeding purposes, or it may be used by simply diluting it with about twice its volume of water, in which condition it is given by itself, or it is sprinkled upon dry hay or other dry fodder. The quantity of molasses used per day depends upon the kind of stock to which it is fed. In beginning the use of molasses as a part of the daily ration it is advisable to start with about one-fourth of the desired quantity, and gradually increase the amount from day to day until the full ration is given. The greatest direct value of the molasses as a stock food is in the sugar, but the non-sugars undoubtedly aid and stimulate digestion, and are therefore of great value indirectly if not fed in too large quantities."—Dr. Townsend.

Molasses combination—13,800lb. volunteer hay at $2 per ton	$13·80
Cost of cutting at $1·25 per ton	10·35
12 barrels molasses at $1·25	15·00
2 tons rolled barley at $30	60·00
	$99·15

A fodder composed of molasses and beet pulp is in use in Germany, and is also made in the United States.

Saturation Lime.—Account has also to be taken of the value of the saturation lime, which is given gratis by the factory to the farmers supplying it with beet. The quotation for ordinary ground lime in my district is, I find, about 21s. a ton. (Unslaked lime is stated by the Board of Agriculture to range from 10s. to 18s.) But the saturation lime is asserted to be something more.

> The raw juice extracted from the beet (says the handbook circulated by the East Anglia Company) contains organic impurities which have to be removed. To do this, both lime and carbonic acid are used, and after the operation they form a precipitate containing about 33 per cent. of carbonate of lime in a most active state. This carbonate, called saturated lime, is in itself a very valuable manure, its effect being to increase the assimilative power of the soil. It has, moreover, a chemical as well as a mechanical action, the presence of the lime quickening the decomposition of the organic and inorganic elements of the soil. The saturated lime contains, besides carbonate of lime, a large proportion of the organic matters originally absorbed by the sugar beet, chiefly potassium and phosphoric acid, and on that account its use as a manure is strongly advocated. Saturated lime is, of course, mostly recommended for use on heavy land, its effect, entirely mechanical then, being to render the soil more friable, and therefore lighter to work.

The question naturally asked is, What is the physical condition of the lime and its precise value? It has been described to me, in a letter from a Continental correspondent connected with a sugar factory, as being supplied to the farmer in "dry lumps," which are cast on the fields, there to fall to pieces under the influence of the weather. "If the farmer keeps it in stock it will soon become a powder, but then it is very dusty when put on the field." On the other hand, Mr. Petitpierre writes to me: "This lime is never in a dry state, but is delivered to farmers in the form of a thick paste, which is thrown over the land and left to dry in the open air before it is buried in the ground." A German correspondent says, this is the condition in which he receives it. "It hardens and then disintegrates."

> "So far as we have tested lime cake as a fertiliser," writes Dr. Townsend, "it has given satisfactory results in nearly all cases. The difficulty in handling this material and spreading it uniformly over the land is a serious hindrance to its use as a fertiliser. The cost of transportation is also an important consideration."

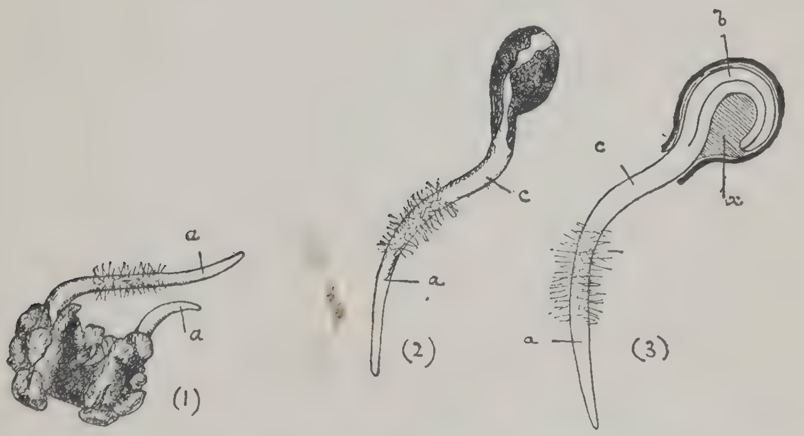
Two analyses of saturation lime are as follows:

	Per cent.	
Calcium carbonate	87·30	40·
Phosphoric acid	1·53	·26
Potash	·11	·15
Nitrogen	·30	·28
Organic and undetermined matter	10·76	5

An American writer says that from 7 to 10 tons of saturation cake, or, as it is called in the United States, lime cake or dried press scum, "have given very favourable results." Mr. Bennett's German farmer puts down the value of the lime he was given by this factory as 1s. 3d. per acre of his wheat crop. Mr. Stein's figure is 5s. Can we say 3s.? I have heard it stated to be just worth its carriage. It has never been proposed to charge for the lime.

It is stated that numerous efforts have been made in the United States to utilise the lime cake in the manufacture of cement, but, so far as can be ascertained, the tests made have not yet been entirely satisfactory. In Germany this industry has reached commercial importance. "That lime cake will eventually be used for some such purpose there can be no doubt," an American writer says. Which hardly looks as if the farmers round the factories were very keen to have it.

The Seed-Case of the Beet.



1. Seed (fruit) of Mangel (of which Sugar Beet is a variety) germinating. *a* primary roots from two separate embryos.

2. True seed separated from 1.

3. Longitudinal section of 2. *a* root; *b* cotyledons; *c* hypocotyl; *x* endosperm.

CHAPTER XVIII

THE FURTHER RETURN

Outstanding Facts in Germany.—I remember one who knows a great deal about German beet growing once impressing on me that our farmers did not understand how Continental agriculture was based on the beet crop.* Through the manuring it gets and its general treatment, succeeding crops prosper, and so some of the expense attached to growing it is debited to the corn crops. Some light is thrown on these matters by the Maidstone Report:

> The importance and value of beet growing is not to be gauged by the profit derived from the crop itself, but rather by its effect upon the whole rotation or, rather, upon the whole economy of the farm. It amounts to a premium on good farming. [" Very true," interjects a German reader of this paragraph.]
>
> Whereas an English farmer is commonly bound by contracts in his

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* " In Germany, France, Austria-Hungary, and Russia, in districts where sugar beets are the principal crop, it is the basic feature of agricultural husbandry. It governs the plans of the farmer and enters into the formative schemes of all local enterprise and the hopes of family prosperity. There are large areas known as sugar districts."—" Progress of the Beet Sugar Industry in the United States in 1909." (U.S. Department of Agriculture.)

lease or agreement (which he constantly evades, and which he is now encouraged by law to evade) not to sell straw off the farm without bringing on a manurial equivalent, the beetroot grower has every inducement to use his straw upon the land.

Whatever rotation he uses, and there seems to be plenty of variety in the matter of rotation, he looks to the fallow or cleaning crop (beets) to yield the best return of the series.

He gets back from the factory a large quantity of excellent feeding material, which he can only turn to the best account by feeding to stock, and for that purpose he requires all his straw for chop and litter.

After deep ploughing and fairly heavy manuring for beets he naturally gets a splendid crop of wheat at a very moderate cost—seven quarters per acre seems to be a pretty generally recognised average. It is the common practice to take another white straw crop after wheat, which shows the lasting effect of the cultivation for beets.

To our mind the great point to be remembered is that the year of *least* profit in any of our rotations is turned into the year of *greatest* profit on a beet farm. The farmer *lends* the produce to the factory, and receives it back slightly reduced in feeding value, but with all the salts and minerals derived from the soil quite intact, and ready to be returned to the land from which they were extracted.

It is not surprising that a few years of this treatment increases the letting value of the land. Agricultural land in the neighbourhood of Magdeburg has doubled in value since the introduction of beet growing.

Some German Figures.—The way in which extensive areas in Germany and elsewhere have been improved by beet culture has been frequently reported upon, and may be put on record :

On one farm, which commenced growing sugar beet in 1883, the average yield of wheat for the six years 1883-8 was 17 bushels (of 60lb.) per acre, but in the years 1889-1894 (it is stated in the *Journal of the Board of Agriculture*) the average yield had risen to 19·8 bushels per acre. In a district of Hildesheim the stock kept before and after the introduction of sugar beet growing (1870 and 1890 respectively) were as follows :—

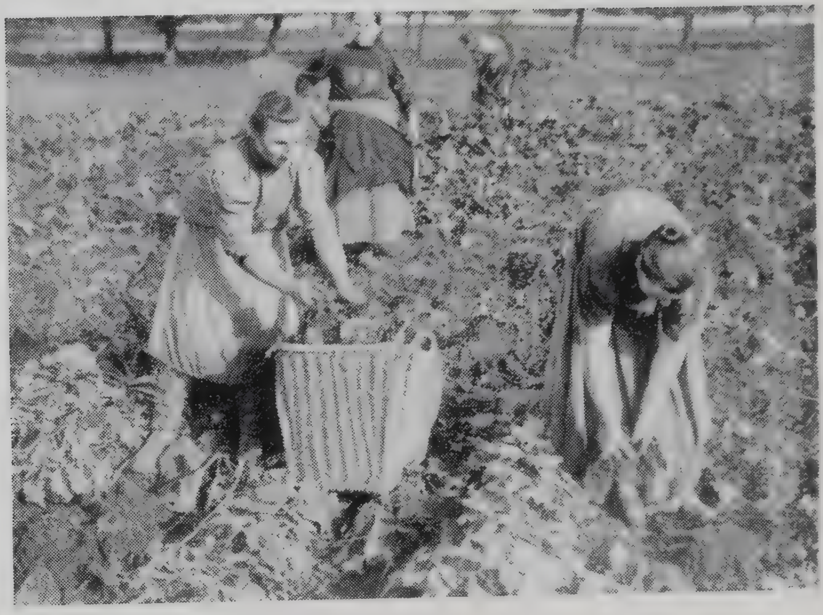
	1870.	1890.
Work oxen	106	594
Cows and other cattle	3,431	5,469
Young stock	732	1,087
Fattening cattle	635	2,681
Pigs	3,146	9,119

Lilienthal estimated, on the basis of eight farms, that the introduction of the cultivation of sugar beet had led to the following increases :—

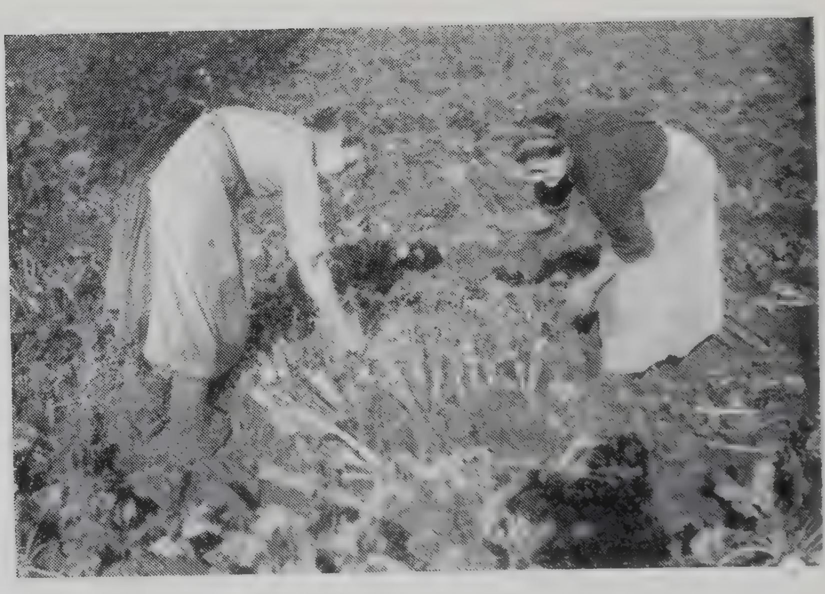
Increase of live stock in the ratio	100 : 115
Increase in corn production in the ratio ...	100 : 111
Increase in dung production in the ratio ...	100 : 132
Increase in wages in the ratio	100 : 141
Increase in net profit in the ratio	100 : 134

"It is probable," the *Journal* says cautiously, "that these increases are to be attributed to the introduction of a profitable root crop where such a crop was not previously grown. The increases would not be applicable in Great Britain, where root crops have long held an important place in farm economy, but the profit, if any, would be that of sugar beet over mangels." This remark as to the introduction of a root crop is applicable to many American sugar beet districts, the results from which are made much of. At the same time it is necessary to give full weight to the actual facts as to the improvement, not in one direction, but in several, which has taken place on the Continent and in the United States as a result of beet growing.

There is no more favourite form of photographic illustration in American journals devoted to beet growing than that showing the fine crops of corn raised after beets. In



Polish Girls Pulling Beets Loosened by the Harvesting Machine



Chopping the Tops off the Beets Laid Out in Rows a publication of the U.S. Department of Agriculture already mentioned there is the following:

> Since it requires intense cultivation, beet is preferable to many other crops for rotation. It leaves the land cleaner and the soil in better condition. Most farmers who have grown beet for a considerable time admit that beet lands are very much improved, that the yield is steadily increasing, the animal industries are especially affected, the labour supply increases annually.*

In the most authoritative work on Dutch agriculture† I find the German author writing:

> It is not only on account of the area covered that beet culture is of great importance for agriculture, but on account of its special characteristics. Everywhere it is carried on the intensity of cultivation is heightened, the fertilisation of the soil is increased, and the cattle feeding is improved.

As to "special characteristics," an English farmer said: "Above all there is the advantage of having the land thoroughly cleaned." Another agriculturist declared that he was content to look at beet as "a cleaning crop instead of a fallow and £1 an acre for the substitute."

The Labour Supply.—One of the results which is counted upon by the advocates of beet growing as likely to follow upon the adoption of the new crop is an increase—slow no doubt, but sure—in the labour supply in beet districts.

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* "In our Eastern, Middle, and Mississippi Valley States, we have nearly reached the limit of productive possibilities with our present methods. Something must be done to bring these lands to a higher state of efficiency. Overworked and poorly manipulated lands must be reclaimed, vitalised, and maintained at their highest yield. To accomplish this we need systematic, organised effort. The highly organised beet sugar industry ought to be a great aid to agriculture at this stage of our development.—"Progress of the Beet Sugar Industry in the United States in 1909."

† *Agrarverfassung und Landwirtschaft in der Niederlanden.—Vide* Chapter XIII.

This augmentation of the labour supply, this increase in the population of rural England, would surely be, altogether apart from the returns obtained from beet growing, a most desirable thing to bring about.

The agent of the U.S. Department of Agriculture says:

> A sugar factory not only intensifies the farming, but makes the land support a larger population. In sugar beet districts the number of inhabitants deriving their living from farming is increased many fold. The factory becomes the nucleus of settlement. Railroads are established, trolley lines built, churches organised, and free mail delivery installed. It also brings together and organises the people of the district for social and business co-operation. We find the people organised for serious consideration of everything that has to do with public roads, schools, churches and social business, and intellectual progress.
>
> One of the first things that will be noticed upon the establishment of a sugar factory in an agricultural district is the influx of labour from varying sources. When a new factory is under consideration for a district the farmer says: "I cannot possibly secure enough help to do the work I now have on the farm; what can I do if I sign a contract to grow an intensive crop like sugar beet, thereby very much increasing the amount of labour required on the farm?" The reply to such a statement is that the sugar factory will solve the problem. To the ordinary farmer this seems paradoxical, but it is perfectly logical. In watching the development of conditions around every sugar factory now in operation in the United States I have yet to find a case where the advent of a sugar factory has not attracted labour, not only for growing beets but for all kinds of farm work.

It is possible, however, to make much too close an application of American experience to English conditions. Large agricultural areas in the United States are at quite a different stage of devolpment from the areas on which the Dutch beet apostles have their eyes in Norfolk and Suffolk.

Intensive Culture and the Result.—Beet growing is undoubtedly a form of intensive culture. It is more like market gardening than agriculture. The ground must be deeply worked, and whether or not the growers' men kneel to single (German children single on their hands and knees)* a great deal of attention—attention which unmistakably shows a return—must be given in providing the plants from their infancy with plenty of air, and with a ground surface free from weeds. "People have no idea," an expert said to me, "the amount of labour the German beet grower puts in his fields. I have seen twenty or thirty people hoeing together.† In Russia twenty or thirty soldiers may be set to work."

Gradually, if large areas are grown, as would be the case were several factories in operation, it is also easy to imagine, brought about by the agency of beet growing, an improvement, not only in the soil and in the commercial situation in the areas concerned, but in the condition of the workers.

It is not merely field labour that is needed—and the tendency of successful beet culture might be to raise wages —but labour for the factories. The permanent all-the-year-round staff at the Dutch factory I describe in Chapter II. numbers 200. The extra sugar campaign staff is such that 100 beds are provided on the premises. The winter hands are chiefly bricklayers, painters, carpenters, brick and field labourers, out of work, or likely to be out of work in the severe weather—a class which is continually moving from our small towns to our big ones because of the shortage of work in the winter.

On the other hand, Mr. Rider Haggard, who notes that the sugar factory he visited in Denmark had 400 hands, is chiefly concerned as to where the labour is to come from:

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* As the Kipling rhyme says:
"Half a proper gardener's work is done upon his knees."

† "I have seen many more in gangs of twenty and thirty," writes a correspondent.

> I know of few districts (he writes) whence 400 or even 200 men could be taken for three months without quite upsetting the local agricultural labour market. Most of the labour will have to come from elsewhere than the surrounding fields and villages, especially as the agricultural operation of lifting the beet must absorb many extra hands.

A German correspondent suggests that more labour would be needed for hoeing than lifting—the difficulty and cost of which, when understood, is exaggerated, he thinks—and that the agricultural operations in connection with the crop would need five times the labour the factories would require. English advocates of beet culture have argued that the factories would attract to the country labour by which the farmers would benefit.

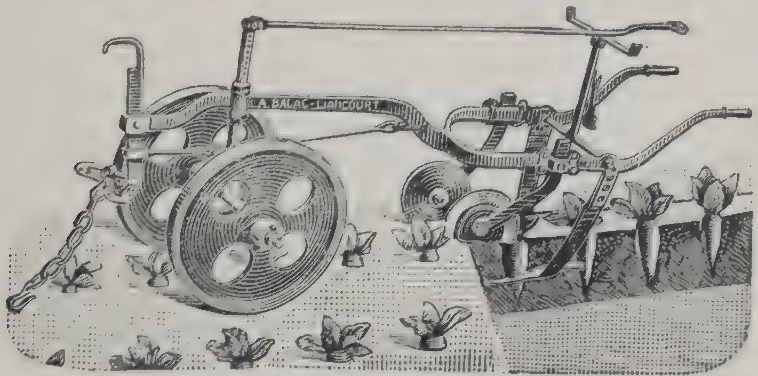
The Influence of the Sugar Factory.—Mr. Charles F. Saylor, of the United States Department of Agriculture, has written enthusiastically of what beet culture can do for the countryside, in the United States at any rate:

> Sugar beet culture came to us as the highest type of agricultural methods. The plant itself is the product of high breeding. The methods necessary to its success are those underlined with the most careful scientific application. It required all the helpfulness of chemistry, soil mechanics, and practical cultivation. It called for the highest order of tilling, illustrative of the best results to be accomplished by higher methods of farming. Wherever a sugar factory has been installed it has carried with it into the fields the higher scientific supervision and direction of farming. Every sugar factory has an expert agriculturist. Wherever sugar beet culture has been introduced we have also introduced a higher grade of farming for all crops. The sugar factory brings the practical science of the laboratory into actual performance in the work of the farm. It demonstrates the actual value of improved methods applied scientifically. To make a success, everything from start to finish is designed for a purpose and must be done exactly right.

This is all true, but, again, it is necessary to note the difference between the conditions of American and English agriculture.

A Criticism of the Cane Industry.—Mr. Saylor has let himself go on the merits of the beet industry in contrast with those of the cane industry:

> There is a vast difference from a moral, civic, or philanthropic standpoint. The production of cane sugar is purely a commercial, selfish proposition. A very intelligent cane sugar manufacturer of the tropics once made this statement to me: "Wherever you see a success of cane sugar production you will notice it is a blight on everything else." There is absolutely no gainsaying this proposition. The plant, large manufacturing buildings, a large body of outlying lands, a few experts manipulating the work of the factory and the work in the fields growing the cane. You will find all the rest of the hundreds of employees in the fields and factory ignorant, degraded, scantily civilised, poorly clothed and fed; in fact their principal garb is sandals and sunshine; people working for a few pence per day, with no social advantage whatever; nothing to elevate or advance their situation. The lands of the entire district must be given over to the production of sugar. Sir Walter Scott's Gurth in "Ivanhoe," with his brass collar, would be a statesman beside many of them.

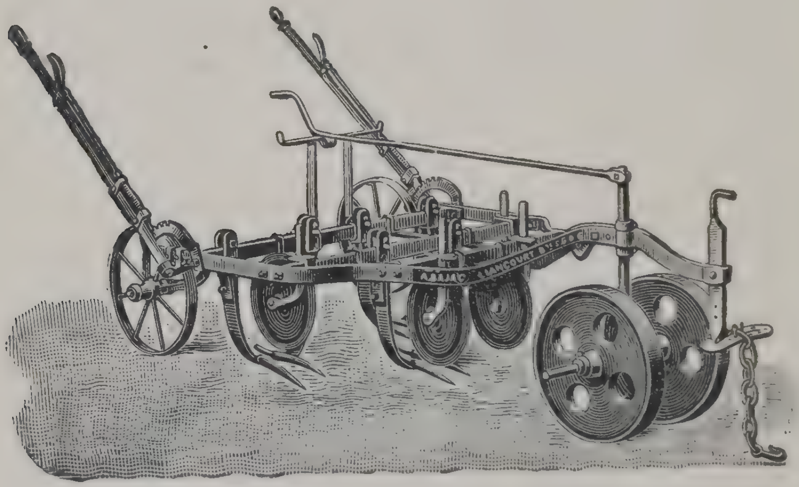


FRENCH HARVESTER WHICH LOOSENS ONE ROW OF BEETS AT A TIME.
The soil is cut away in the drawing to show the working of the prongs of the plough.

> A beet sugar factory presents an entirely different picture. You will find lines o transportation, both railroad and trolley; every

convenience of communication of a prosperous, civilised community, and that it has attracted to itself a busy centre endowed with all the modern improvements of suburban line, free mail, free school, under the influence of Press and pulpit. The lands are owned by the men who produce the beets. The productiveness and life-sustaining qualities of the land are so much enhanced that settlement is very much concentrated, and to the district come all the social and educational advantages that accrue to closer association of population. Instead of degrading, the producers of the raw product gradually improve, and the whole system tends to a very much improved condition of affairs. To produce our own sugar means exactly this to many districts.

I do not understand, however, that American beet sugar factory proprietors are wholly philanthropists. They already enjoy, the United States being outside the Convention, Protection to the tune of 7s. per cwt. Even this does not content them. Their organ in the Press loudly demands that they shall have "adequate and permanent Protection," whatever that may be!



French Harvester which Loosens Three Rows of Beets at a Time.

CHAPTER XIX

A PANEGYRIC ON SUGAR BEET

By TRUMAN G. PALMER,

Secretary of the American Sugar Beet Association.

[Just as in the next Chapter there is set out the worst that can be said against beet growing and a beet sugar industry, the most that can be said for both is here stated. It is worth while to put the case for each side in its own words, and it is fortunate that statements should be available by as convinced disputants as Mr. Palmer and Mr. Lloyd. The present Chapter is a summary of an address delivered at the twentieth session of the Trans-Mississippi Commercial Congress, Denver, Colorado, August 7, 1909. The chief reason why it is shorter than the next chapter is that I have had to cut out much of Mr. Palmer's paper, because his points are already made elsewhere in this book.—" H. C."]

Indirect Agricultural Advantages of the Crop. — The Secretary of the United States Department of Agriculture says that the production of our sugar at home will go farther toward raising our standard of agriculture than will any other one thing. The agricultural scientists I met in Europe told me that the production of sugar had been the greatest factor in the advancement of agricultural science in Europe.

It should be patent to anyone that inasmuch as we are perfectly capable of producing at home the enormous quantities of sugar we annually import, we ought to produce it at home.

In the second place, inasmuch as it takes all the money we secure from 13,000,000 acres of wheat to purchase the sugar we could produce from 2,000,000 acres of sugar beets, it would appear that we should make more money if we grew the 2,000,000 acres of sugar beets and turned the remaining 11,000,000 acres into meadows, and thereby increase our rapidly decreasing herds.

But these reasons pale into insignificance when compared with the indirect agricultural advantages to be gained by producing our sugar at home. The main advantages come through rotating other crops with sugar beets and through the agricultural science which a beet sugar factory brings into a community.

Educational Influence of the Factories. — European economists told me that if cane and beet sugar could be produced alongside of each other, the former at a direct cost of 2 cents per pound and the latter at a direct cost of 4 cents per pound, the 4 cent beet sugar would be the cheaper sugar for the nation, because the indirect agricultural advantages which are to be obtained through rotating with sugar beets amounts to even more than the entire cost of producing the sugar, while sugar cane is an agricultural Juggernaut which mows down and blights every other form of agriculture with which it comes in contact.

Every beet sugar factory is equipped with a corps of men skilled in agricultural science, and these men are in touch with the farmers of the community constantly. Not only do they teach the farmers how best to grow sugar beets, but they teach them how to grow other crops, and, most valuable of all, they teach them the necessity and the science of rotation. In Europe a beet sugar factory is

Thrifty Seed Beets in Bloom

Note how large the heads are in proportion to the beets

Wohanka Beets.

Richest in sugar Heaviest in yield

regarded as being as valuable to the nation as a government agricultural school.

How to Lose Money by Beets.—In the first place, let me say that no man who farms sugar beets in a slipshod manner can make a cent at the business. Shiftless farming methods may yield a small profit when applied to producing most of our other crops, but every farmer who does not take reasonably good care of his sugar beets will lose money on the crop. This is a fact which the factory agriculturists din into the farmers' heads from morning to night, and wherever you find farmers making money in growing sugar beets it is safe to conclude that in the production of this crop, at least, they use better farming methods than do farmers who do not raise beets. In due course of time the employment of these better cultural methods extends to other crops and then you have a scientific farmer. In the next place, sugar beet culture rids the land of weeds, wild oats, and other undesirable vegetation. And now we come to the greatest factor of all.

In ploughing for grain, we usually turn the soil over to a depth of 6in., sometimes 7in., but more often 5in. Beneath the soil we turn over, the ground is so hard the grain roots will not penetrate it, and consequently all the nutriment our crops receive is drawn from the five to seven inches of top soil. To prepare the soil properly for sugar beets a sub-soiler is employed which stirs the soil to a depth of from twelve to fourteen inches.

The Wonderful Roots of the Beet.—The general conception of a sugar beet is that it is one large root, but this is erroneous. In addition to the main root there are a multitude of small fibrous roots which nourish the main one. These fibrous roots go down as deep as the earth is stirred and sometimes even deeper. When the main roots are ploughed up in the fall, the fibrous roots are broken off in the ground, and, in rotting, add humus to the lower strata of soil, also leaving minute interstices to the full depth that they have penetrated. When other crops follow beets, the roots, instead of going down only to the depth of the ploughing, find the little enriched interstices left by the decayed minute beet roots, and following them on down, they draw nutriment from 12in. of soil instead of from 6in. of soil. In other words, the culture of beets doubles the soil without adding to the acreage.

Sugar beets are drilled 18in. apart, and are thinned to 8in. apart.* With a perfect stand, this gives over 43,000 beets to the acre. While all of the longer fibrous roots, from the size of a pin to double the diameter of a knitting needle, break off in digging, there are on a beet which has been carefully dug as a specimen many rootlets from 1ft. to 2ft. in length.

A Ton of Humus per Acre.—When dried, the fibrous roots attached to each beet will perhaps weigh only one to two ounces, possibly even less than an ounce. If they average but three-quarters of an ounce to the beet, they carry down into the under strata of soil over one ton of humus per acre. Is it any wonder that such wonderful results are obtained through rotating other crops with sugar beets? How much money do you suppose it would cost to purchase a ton of decayed vegetable matter and distribute it evenly over an acre of ground and then bury it to a depth of six to fourteen inches, where it is most needed? Such an operation on a field of any size would bankrupt any ordinary farmer. Yet this is just what the culture of sugar beet does for our farmers, and at no expense whatever. In fact, it does it for him and pays for the privilege of doing it, inasmuch as, without considering this advantage, the beets themselves yield the farmer the greatest profit of any crop he can raise.

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* Note by a German correspondent: "May be done in America, but 16in. by 9in. or 10in. is better."

Besides this, sugar is carbon, hydrogen, and oxygen drawn wholly from the atmosphere, being merely the sunlight, the rain, and the wind which sweep over the fields. The farmer who turns back all the by-products loses nothing from his soil, while with wheat, every 30 bushels carries away 62 pounds of nitrogen, 20 pounds of phosphoric acid, and 26 pounds of potash, fertilising elements which to-day are worth £1 18s. 8d. in the markets of the world.

The Known Results of Beet Culture.—And now as to the known results of beet culture concerning the indirect agricultural advantages. I have a German report, made many years ago, which opened the eyes of all Europe, and to no small extent accounts for the prevailing desire in Europe to produce all the sugar possible and export it at a loss if necessary. As the farmers of Europe get far less money per ton for their beets and more money per bushel for all other crops they raise than do the farmers of the United States, it plainly is to be seen that it is not the direct results which attract them to beet culture.

This German report I speak of, which, I believe, was made back in the sixties and seventies by a pupil of Prof. J. Conrad, the highest German authority on agricultural economics, is made up from an accurate record of thirty-five farms in Saxony of 500 to 1000 acres each, the record being for a period of ten years prior to beet culture and five years subsequent to the adoption of beet culture on the same farms, showing in pounds per acre the amount of crops taken off before beet culture was introduced and after beet culture was introduced, when the crops were rotated with beets, beets being grown on the same soil once every five years.

Reduced to bushels, this report shows that on these thirty-five farms the average yield of wheat per acre prior to beet culture was 30·8 bushels per acre, and that after beet culture the yield was 38·2 bushels. The present average yield for all Germany is 29·6 bushels, and so it will be seen that in wheat production these farms prior to beet culture were above the present average yield of wheat. The rye produced on these farms prior to beet culture was 26 bushels per acre, a fraction above the present average yield of 25·7 bushels for all Germany, and after beet culture it averaged 29·8 bushels. The barley yield on these farms was 34·8 bushels per acre, a fraction under the present average yield of 35·2 bushels for all Germany, and after beet culture it was 43·6 bushels per acre. The average yield of oats before beet culture was 42·3 bushels per acre, and after beet culture it was 59·9 bushels, which is just above the present average yield of 58·3 bushels for all Germany. The average yield of potatoes before beet culture was 111·9 bushels per acre, and 226·5 bushels after beet culture, which exceeds the present average yield for all Germany by 21·5 bushels. The yield of peas was increased 86 per cent. through the introduction of beet culture.

The Money Aspect.—Reduced to money equivalent, the value of this increase in the yield of other crops through rotation with sugar beets far exceeded the gross amount received for the beet crop. In round numbers, Germany to-day grows 1,100,000 acres of sugar beets, the returns from which amount to about £10,416,666 13s. 4d.* In rotation with these sugar beets the German farmers cultivate some 4,400,000 acres of wheat, barley, oats, rye, and other crops, and from the excess yield of these other crops, by reason of growing them in rotation with sugar beets, the German farmers receive over £20,833,333 6s. 8d., or double what they get for their beets. Is it any wonder

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* I have converted Mr. Palmer's dollars and cents.

Field of Sugar Beet Seed in Germany

that Germany produces over 1,200,000 tons of sugar annually for export, and is willing to sell it in the world's market at a loss when, for every shilling's worth of beets they grow they get two shillings' worth of excess of other crops? German officials told me that if by trade treaty we could enable them to market an extra million tons of sugar in the United States without injuring their other foreign markets, they would be willing to throw down all trade barriers to the United States and let our goods in free of duty. They admitted that they would be by far the largest gainers by such a trade deal.

Applying Sugar Beets to the Land.—Sugar beets are not over rich in fertilising elements, but by opening up and enriching the lower strata of soil and making it pay tribute to the farmer, they increase the productivity of the land even more than do fertilisers, though, to obtain maximum results, both should be employed. When we apply fertilisers, the only return for the expenditure of money and labour is in the increased yield of the crops, but when we apply sugar beets, we more than get back our money from the sale of the beets, and we secure larger yields of the other crops which follow, than as though we had expended a large amount of money in applying fertilisers. What would we pay a ton for a fertiliser which in itself would return a by-product worth far more than its cost, and in addition, on the land to which it was applied, would increase the production of all other crops to a greater extent than will any other fertiliser we can buy? Considering the fact that sugar beets are one of the most profitable crops which a careful farmer can grow, and the further fact that they so materially increase the yield of other crops, they come nearer than anything else to disproving the old statement "you can't eat your pie and keep it too."

Some American Figures.—For ten years past the average yield of wheat in California has been 12 bushels per acre. I recently received a report from near the Hamilton Californian factory, where a 135 acre field, which has been in sugar beets for two successive years and was then sown to wheat, had been harvested and the yield was 56¼ bushels per acre.

W. T. Wayment, Warren, Weber County, Utah. Ten acres. Previous to raising beets this land produced 25 bushels of wheat to the acre. Beets were grown on the land for three years, after which it was planted in wheat again, producing 45 bushels to the acre. An increase of 20 bushels to the acre.

J. F. Stoddard, Hooper, Weber County, Utah. Five acres. Previous to growing beets the land produced 35 bushels of barley to the acre. Beets were grown on this land for four successive years, after which the land was planted in barley again and produced 55 bushels to the acre. An increase of 20 bushels to the acre.

Thomas Jones, Hooper, Weber County, Utah. Ten acres. Previous to planting of beets this land produced 20 bushels of wheat to the acre. After growing beets for three successive years it was again planted in wheat and produced 35 bushels to the acre. An increase of 15 bushels per acre.

That sugar beet culture in itself, without taking into consideration the indirect agricultural advantage, is profitable is shown by the fact that the longer a farmer grows beets, the more anxious he is to do so, and the further fact that, in spite of the advice of the sugar companies' agriculturists, farmers will persist in growing beets on the same land year after year instead of but once in five years.

CHAPTER XX

THE WORST THAT CAN BE SAID AGAINST BEET GROWING AND A BEET SUGAR INDUSTRY

By F. J. LLOYD, F.C.S., F.I.C.

[BEET sugar propaganda is so much in need of sincere and searching criticism that if Mr. Lloyd did not exist he would have to be invented! For several years Mr. Lloyd, who is well known as a dairy chemist and bacteriologist, has maintained an attitude of scepticism towards both beet growing and beet sugar manufacture in this country. In my opinion, the paper which he read at the Surveyors' Institution on February 20, 1911, is of great value as a statement of the case against a beet sugar industry. The very worst that can be said against it is now known, and it is important to put it on record. I am much indebted to the kindness of Mr. Lloyd and the Council of the Surveyors' Institution for permission to reproduce the paper, with a little condensation. From the subsequent debate I have extracted and arranged in their proper places the various arguments brought forward at the meeting by advocates of factories in opposition to Mr. Lloyd. I have also added some notes kindly sent me by Mr. Martineau. Beyond a reference to figures in two footnotes I have refrained from making memoranda on my own account.—"H. C."]

Speculative Estimates.—Granted that we can grow sugar beets, the questions, What yield per acre? and What percentage of sugar may be obtained? can only be answered by years of experience. No single experiment, no group of experiments, in one year, or even two years, can answer this question. Much less can the farmer estimate from such experiments what might be the average cost of cultivation for an extensive area or the average yield per acre under such conditions. Hence most of what has been written about sugar beet cultivation in England has been mere speculation.*

Questions about a Factory.—The success of a factory depends upon three factors: the price of the manufactured article, the cost of manufacture, and the cost of the raw material. The cost of manufacture in any given enterprise is the factor least liable to fluctuation. If, therefore, the price of the manufactured article is liable to fluctuations, so also must be the cost of the raw material. Otherwise this must be fixed at a constant price based on the average lowest prices of the product. If not, then it is perfectly evident that in some years the factory would be run at a loss, and a series of such years would spell bankruptcy. For any undertaking to promise the producer of the raw material in advance for a series of years a price above what the lowest average of the manufactured article would permit would necessarily be to tempt failure.†

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* We have the results of forty years' experience in France, Germany, Austria, &c., on record down to the minutest details.—MR. G. MARTINEAU.

† In practice there is an "average price" and an "average cost"; these are the truisms of every business.—DR. G. SCHACK-SOMMER.

Presuming we have a factory, we should be able to make contracts for five years ahead for our required quantity of roots, and this would suit the farmer as he would know he had an assured price for his roots; and surely it is a far sounder commercial proposition to have a fixed price for the raw material, to know almost to a penny per ton what it costs to manufacture sugar, and to know that year in and year out you must make the average price for your sugar, than if you

Before capital can be obtained the capitalist will ask, first—What security have I that my capital will not be lost? and, second—What interest will you guarantee me, or at least give me reasonable grounds to anticipate? What security is there for the capital invested? A large portion of it would be sunk in buildings utterly useless for any other purpose than as a sugar factory; and were the undertaking to prove a failure that money would be lost. The Government has been asked to assist the industry for five years. What use is that? Who would invest capital on a chance that at the end of five years it would be lost.*

Another large portion of the capital would have to be invested in machinery. But machinery does not last for ever, and even supposing we give it a life of twenty years, at the end of that time the capital will be lost unless there has annually been put aside a sum equivalent to the annual depreciation. Such sum can not in any sense be looked

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are subordinate to violent fluctuations of your raw material, such as cotton, for instance, and where perhaps two purchases in the year on the top of the market may turn your manufacturing profits into a loss.—Mr. F. F. Kemp.

The cost of manufacture also depends on the yield of sugar from the roots. Mr. Lloyd forgets this. With a yield of 16·64 per cent. a factory made a profit of £49,000 in spite of the fact that it paid 21·136s. a ton for its roots and only got 10s. per cwt., basis 88 per cent. f.o.b., for its sugar. Part of its £49,000 was given away as a bonus to the farmers, who therefore got more than 21·136s. for their roots. (*Vide* Appendix.)—Mr. Martineau.

* Personally I do not think the Government should be asked to give any guarantee at all. We do not need it, and neither growers nor manufacturers want it. Its only possible advantage might be that it might offer a certain amount of encouragement to people to come forward with their capital, but, as far as the industry is concerned, it would not be dependent on a Government guarantee.—Mr. G. L. Courthope, M.P.

upon as annual expenditure on manufacture. It would be what I should term a sinking fund to replenish loss of capital. If you will assume that the whole of the capital has been lent for a definite period of years, at the end of which it has to be returned, you will perhaps better realise the necessity of this sinking fund. A considerable portion of the capital will be invested outside the actual factory, in means for receiving the roots, storing them and washing them, also in appliances for disposing of the refuse of the factory—a very serious problem to which I shall revert. Evidently all this capital is lost if the factory fails.*

The Price of Sugar.—Let us, then, examine the financial position in other countries, remembering that the average price of beet sugar is about £10 a ton.

That recognised authority on sugar, Mr. Geo. Martineau, C.B., in his interesting little book on "Sugar" says: "In the most advanced beetroot country, Germany, the average cost of production is about 9s. to 9s. 6d. per cwt." The cost of production, so far as I can ascertain, in all other countries is higher than this. How, then, can we hope to make sugar production a profitable industry in England until the price of sugar has permanently risen far above that at which it now stands? Some people think it will rise. Judging from the rapid development which is taking place in the cane sugar industry in various countries, I doubt it. That the price will fluctuate with seasons of scarcity or excess is certain, but it would be most unwise to build up a new industry on such a shifting-sand foundation.

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* This is an argument against any form of enterprise.—DR. SHACK-SOMMER.

Every factory in the world writes off depreciation as part of the working expenses.—MR. MARTINEAU.

Some American Figures.—Let us pass to the United States, where for many years the Government has done everything in its power to foster the beet-sugar industry. For no pursuit has the Department of Agriculture been more anxious, while its chief chemist, Dr. Wiley, has contributed year after year since 1890 most valuable reports to advise those engaged in the industry. Every factory but one started in the United States prior to 1890 has failed. Those who would start a factory in England might do worse than study the causes of these failures before they themselves made the same blunders. To-day, however, there are 63 factories in the United States, and the following figures relating thereto, and taken from a Congress Document No. 523, May, 1908, are of interest:

AMERICAN BEET SUGAR INDUSTRY, 1906.

Number of factories	63
Capital invested	$91,037,500
Tons of sugar produced	483,612
Value of product	$43,543,000

	$
Paid to farmers for beets	22,027,000
,, factory mechanics and labourers ...	5,825,760
,, to superintendents and clerks	1,293,200
,, to officers...	619,000
Paid for coal and fuel oil	2,516,800
,, coke	1,780,800
,, lime-rock	678,400
,, cooperage and bags	848,000
,, freight on beets	1,967,000
Total expenditure above enumerated	$37,555,960

NOTE.—Mill and miscellaneous supplies, repairs, and new machinery are not included in above.

From this table we find, by deducting the expenses from the value of the product, that the balance is $5,987,040
If we deduct 4 per cent. of capital as sinking
fund $3,641,500

We have left $2,345,540*
which on a capital of over 91 million dollars practically represents 2½ per cent. interest. It really does not amount to so much in view of the note that repairs and new machinery are not included.† Further, if you divide the value of the product by the tons of sugar produced, it will will be seen that the sugar was valued at $90 a ton, or £18. This is due to the fact that there is a duty on sugar of over £7 to the ton.

In spite of this high price of sugar and the small amount of interest which the capital brings in, the farmer is only paid "on an average $5 a ton," "though some factories have been paying as much as $5.50 per ton for several years." This price (20s. to 22s. per ton) seems perhaps high. We shall see.

In spite of these conditions, two facts are strikingly brought home to the student of the beet sugar industry in the United States. First, that the factories have a difficulty in making both ends meet, and, secondly, that those which succeed find it difficult to obtain the necessary supply of roots. These assertions are well illustrated in a

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* America is no guide. Why does not Mr. Lloyd quote figures from Germany and Austria?—MR. MARTINEAU.

† The figures quoted by Mr. Lloyd show that the sale of sugar alone paid all expenses, and produced a clear 2½ per cent. on the capital, and all the by-products were thrown in. These latter are entirely omitted from the paper. If they could pay 2½ per cent. with the by-products in their pocket there was nothing to complain of.—MR. COURTHOPE.

Senate Document, No. 22, of 1909, where we read: "During the six years (1896-1901) forty-one factories were put in operation, of which seventeen failed later." "During the seven years (1902-1908) two of the forty factories completed and operated failed later."

In support of the second assertion this same Document states that:

> The serious problems facing the beet sugar industry to-day are not those of soil and climate. These may be considered settled in favour of the industry. The real problems now to be solved are economic. The main questions are: (1) How to secure a satisfactory supply of labour for growing beets; (2) How to maintain and extend beet culture in competition with farm crops.

Every word in this sentence would apply to, and might have been written with regard to, the proposed introduction of the beet sugar industry into this country.*

An English Prospectus.—In view of these facts one is puzzled to know on what grounds financiers are asked to invest capital in this undertaking of beet sugar production. I fail to obtain a businesslike financial prospectus which would carry conviction as to the profit likely to accrue. As an illustration of the schemes put forward, let me take one from a paper by Mr. J. Saxon Mills in the *Fortnightly Review* for November, 1910. To show "the financial prospects for the investor," he gives "an estimated balance of receipts and expenditure" for a factory to deal with 34,000 tons of roots, the produce of 2000 acres at 17 tons per acre.†

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* Mr. Courthope quotes in reply the U.S. Government Report, extracts from which appear in Chapter XVIII.

† There is no authority in this country for 17 tons, scrubbed roots.—H. C.

These are the figures :—

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
3604 tons granulated sugar at £12	43,248	0	0	34,000 tons beet delivered to factory at 17s. 6d. per ton	29,750	0	0
3740 tons slices at £5 10s. per ton	20,570	0	0	Manufacturing and other expenses at 7s. 6d. per ton	12,750	0	0
272 tons molasses at £3 15s. per ton	1,020	0	0	Depreciation, 10 per cent. on machinery ...	5,890	0	0
				Depreciation, 5 per cent. on buildings and constructional ironwork...	1,472	10	0
				Balance for profit	14,975	10	0
	£64,838	0	0		£64,838	0	0

Let us examine these figures first on the expenditure side.

1. The farmer is to be paid 17s. 6d.[*] a ton for the roots. Will he be satisfied? I think not, in view of the facts which I propose to put before you, and others which have recently been gathered in connection with the cultivation of beets in East Anglia, the results of which experiments have been most fully described in an admirable series of articles in the *Field*, which will, I hope, be reprinted and carefully studied by all who are interested in this question.

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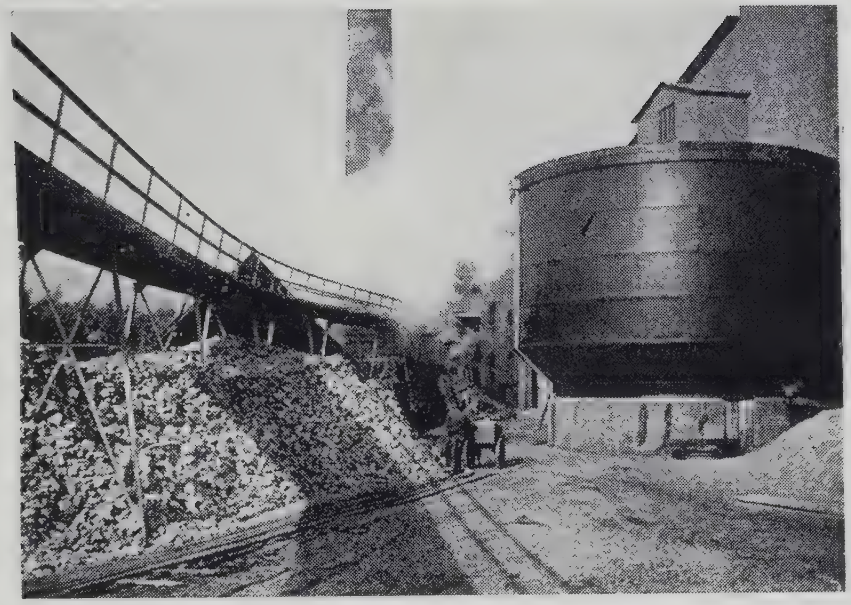
[*] More is now offered.—H. C.



Limestone at the Hollandia Factory, with a View of Molasses Tank

A Corner of a Sugar Warehouse in the same Factory

2. The manufacturing expenses are those of the best factory work and represent £3 10s. per ton of granulated sugar produced.

3. The estimated expenditure appears to be—

	£
On machinery	58,900
On buildings, &c.	29,450
	£88,350

Nothing is said of the working capital required. We may estimate this at £30,000, making a total capital of £120,000.

Value of Products and By-Products.—Passing now to the receipts side. If we wanted to carp we might criticise the £12 per ton credited for granulated sugar as too high; let this pass, however.*

The price of the molasses we must protest against. This is only suitable for cattle feeding, and contains nothing of value save its 50 per cent. sugar. A fair price would be 50s. a ton, an outside price £3.†

But by far the most important item is the value attributed to the dried slices. It will at once be seen that all the profit and more than the profit depends upon the assumed value of these dried residues as food for stock. In fact, according to this balance sheet, it is almost as much a cattle food industry as a sugar industry. While there can be no doubt that the consumption and demand for sugar by man is great and increasing, there is no reason to suppose that any demand exists or is likely to exist for this residual cattle food. Moreover, the figures here given will not bear investigation. Claassen, one of the greatest authorities on beet sugar, says that the dried slices represent about 6 per cent. of the roots employed. Instead, then, of 3740 tons there would be only 2040 tons available.*

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* The average price for 88 per cent. beet for the last seven years was 10s. 5d., giving an average price for granulated of 12s. 5d. per cwt. or £12 per ton.—DR. SCHACK-SOMMER.

† The price of molasses paid to-day by makers of cattle foods was much higher than the £3 suggested, and he had lately to pay £5 a ton for cattle-feeding treacle which was bought to execute orders. Then, again, German up-to-date beet sugar factories no longer turned out molasses. Their products consisted of a first and a second product sugar and slices. (*Vide* balance sheet of factory in Appendix.).—*Ibid*.

The dried pulp is just the kind of artificial food for which the English farmer has least need. It is poor in oil and in albuminoids, and its chief feeding value lies in the carbohydrates. But these are the constituents most easily obtained in farm crops and cheap foods. They would be still more easily obtained if the molasses of these sugar factories were also placed on the market in the form of cattle food as it is necessary they should be. I estimate that £4 a ton would be fully as much as the farmer would be justified in paying for this material. We must also take into consideration that the English farmer has had no experience in its use, and will take some time to learn how to use it to advantage.

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* The dried slices represented about 11 per cent. of the roots employed by working according to Steffen's process, by which a considerable proportion of the molasses is left in the slices.—Dr. Schack-Sommer.

The Kruschwitz factory (*vide* Appendix) had 2603 tons of pulp from 135,959 tons of roots. Perhaps some went away wet on part of the contract with farmers. Probably that is so. Anyhow, they got £8335 for it after deducting expenses of drying. The expenses must have been at least £1500. £9835 for 2603 tons is at the rate of £3 15s. 6d. a ton. Mr. Saxon Mills must have taken wet pulp quantity and dry pulp price. The net profit on the dried pulp, £8335 on 2603 tons, is £3 4s. This is the proper figure to take.—Mr. Martineau.

The 2040 tons at £4 a ton would represent only £8160, instead of the £20,570 in the estimate under consideration.*

The balance of profit would thus be reduced from about £15,000 to under £3000, which would not afford much interest on the £120,000 invested.

Apart from these details, and on general principles, it must be universally recognised that a manufacturing industry which depended for the whole of its profit, and even some of its expenses, on the sale of a by-product, was not financially sound.†

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* The German War Office are enormous buyers of dried slices for feeding their calvary horses, which are the finest in the world. One of the largest and most scientific farmers in this country has been in the habit for some years past of importing large quantities of slices at a cost averaging £6 per ton. He has himself carefully superintended the feeding of his stock with them, and is of opinion that there is no other food to compare with sugar slices, and he states definitely that the results of feeding his stock with one ton of slices at £6 per ton and one ton of linseed cake at £10 per ton has invariably turned out much in favour of the sugar slices, and at a saving of £4 per ton consumed. The same farmer also offered and is still willing to contract for 5000 tons of slices annually at £5 per ton, should a factory be started in his neighbourhood, and he told me that what he could not use himself he would be able to sell at a profit to his friends and neighbours.—Mr. Kemp.

† What about most of the gas companies? For several years the amount received by the London General Omnibus Company for its advertisements was greater than the amount available for dividend.—Dr. Schack-Sommer.

Every manufacturer in a large way of business knows that profits depend to a very large degree upon the price he can make of his residuals. In Bessemer steel there is basic slag. In gas, sulphate of ammonia. In flour milling, the offals.—Mr. Clement Dalley.

A Revised Factory Estimate.—I would like to suggest for your consideration another method of estimating the financial position :

ESTIMATE OF BEET SUGAR FACTORY.

Capital ... £100,000.

	£
Invested in machinery	50,000
Invested in buildings	25,000

RECEIPTS.

5000 tons 88 per cent. sugar at £10 per ton ...	50,000
2000 tons dried slices at £4 per ton	8,000
350 tons molasses at 50s. per ton	825
Income ...	£58,825

EXPENSES.

Interest on £100,000 at 4 per cent.	£4,000
Sinking fund 10 per cent. on machinery	5,000
Sinking fund 5 per cent. on buildings	1,250
Cost of manufacture at £3 a ton	15,000
	25,250
Leaving for roots	33,575*

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* In giving the capital cost of the factories, Professor Lloyd has in every case taken the increased cost of factories that would turn out granulated sugar, but the profit he has taken is on raw sugar. Then he had, perhaps intentionally, ignored the fact of the by-products. He thought he had therefore misled himself as to the possibilities of that industry in England. If it paid foreign countries to purchase beets in England, ship them to Holland, and send the product back in the form of sugar, paying the duty of £1 16s. 8d. and the freight from Hamburg to the warehouse in the City of at least 12s. 6d., surely it would pay them in England to manufacture sugar within a reasonable reach of where those crops were grown.—MR. COURTHOPE.

For the financier, the enterprise, for the reasons he had previously given, was a fair and promising business risk. It was not, however,

Roots required :—

If containing 13 per cent. sugar	...	40,000 tons	at 16s. 9d. per ton.
,, 15 ,, ,,	...	35,000 ,,	19s. 0d. ,,
,, 17 ,, ,,	...	30,000 ,,	22s. 4d. ,,

Assuming that the capital invested is sufficient, on which point there may be some doubt, the only question which remains is, Would it pay the farmer? Before discussing this there is, however, one subject I should like to mention briefly.

The Factory's Water Problem.—Success in beet sugar production depends largely on the site of the factory. An abundant supply of water is the primary requisite. It is stated by Lichowitzer that the amount of water used by a factory is eleven times the weight of roots used, so that a factory dealing with 35,000 tons of roots uses 86,000,000 gallons of water. This is probably the minimum intake. Having been used, the waste water has next to be disposed of, and being now highly contaminated with waste material and therefore liable to undergo fermentation, considerable expense is involved in its treatment, but as soon as possible it is turned into the stream to flow to the sea. The grosser refuse is allowed to settle in tanks and removed by sieves, but even then, says Claassen, the partly purified waste waters, "though not injurious to man or animals, make the stream into which they flow unfit for use, owing to their bad smell and taste, and frequently kill the fish owing to the evolution of sulphuretted-hydrogen gas." Evidently the evil effect of this waste water must depend upon the volume and flow of the stream. But I have never seen any notice of this all-important consideration;

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one which would stand intermediate or promotion profits or founders' shares. Only if started on sound business lines had it a chance of success.—DR. SCHACK-SOMMER.

and any factory built without due regard to it would soon be involved in legal difficulties with riparian owners.*

Farmers and the By-Products.—Would it pay the farmer to grow beetroots? It has been suggested that the farmer would gain three advantages from this industry—

First.—A price per ton for his beet crop which would afford a large profit on cost of production.

Second.—A new source of cattle food from the dried slices and molasses.

Third.—The lime cakes made in the purification of the juice.

The last item we may at once dismiss as imaginary. A beet sugar factory must be in a position where it can obtain lime reasonably. If a farmer in the neighbourhood wanted lime, it would probably pay him better to use it fresh than to cart or carry these wet cakes to his farm, dry them, pulverise them, and then apply to the land.†

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* If Professor Lloyd studied the experience of Continental factories, he would find that it was possible, and, in many districts where water might be a difficulty, it was the practice to use the water over and over again. He admitted it involved more cost in machinery; but it did away with the difficulty of obtaining a very large supply, and partially did away with the difficulty of disposing of the waste. Many different purifying processes had also been adopted, and some so dealt with waste water as entirely to remove the obnoxious and offensive matter from it, and he was informed by many authorities that the water could be sent into any stream straight from the manufacturing process.—MR. COURTHOPE.

The water used for washing out the diffusion battery is foul, but the water used for condensing is cooled and used again. The bulk of the water used in a sugar factory is for condensing purposes.—MR. MARTINEAU.

† Why? The lime was usually found in an excellent condition for immediate application. The 'saturation lime,' as it was called,

Years ago a similar claim was put forward for the lime cakes of sewage sludge. Farmers soon found they were not worth the cost of carriage.

The dried slices' true value is problematical. That they may have an inflated value in large sugar-producing centres is possible. Why? We shall see later on. The English farmer, then, must consider the first advantage only.

We have as yet no experience in England which enables us to say for certain whether the crop could be produced so as to afford a large profit or not.

That sugar beet can be grown in England of as good quality as those produced on the Continent we do know. What would be the average yield per acre on a series of years when grown in large quantities we do not know. English soil is practically virgin soil so far as the sugar beet is concerned.

The labour demanded by the crop, more especially in keeping it clean, may be easily found for a few experimental acres. But to obtain this labour for some 2000 or 3000 acres situate within a circle of five to seven miles radius is quite another matter. A similar labour difficulty arises in the autumn when the crop has to be gathered and taken to the factory, not as the farmer finds convenient but as the factory wills it.

Climate.—Then, again, the crop is one peculiarly susceptible to climatic conditions both as regards yield of roots and contents of sugar, and we know how treacherous our climate is.

A striking illustration of how intricate this question of

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contained a number of other chemical constituents of great value, giving it a much higher value weight per weight for manurial purposes than the pure lime by itself.—MR. COURTHOPE.

climate is may be gathered from the following facts. Considering what good crops of beets had been grown in our temperate climate last year, I ventured to ask Professor Wiley why the beet zone or belt in the United States was confined to so high a temperature district. His reply was that if extended there would be a chance of early autumn frosts damaging the roots. We may in England be safe on this ground, but what about late spring frosts which easily destroy the young plants? One author goes so far as to say that in such case the land must be cleaned and replanted at once.

Lastly, the beet crop is liable to very many diseases and pests. This should be particularly noted, for it has been stated by those who are tempting farmers to take up this culture that the crop is one peculiarly free from disease and injurious insects.*

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* It had never been found that the beet crop had to be harvested in September. Early frost might be laughed at. The beets could stand at least 12 degrees of frost with impunity, and he thought the general experience of this country was that they never got severe frost till about December, and there was very little doubt to his mind that the whole of the autumn could be taken for the harvesting of the crop, which resisted frost much better than mangel for the reason that it was covered up to the crown while the mangel was not. The effect of frost on the young plant was exactly the same as in the case of the mangel.

The same remark applied to pests. He had only heard of one pest which was not common to the mangel that attacked beet. In one district in Germany the beet had been attacked by a nematode, which, it had been suggested, was the same as the eel worm that attacked oats, but he did not think that was clearly established, and those who had inquired on the spot had come to the conclusion that the nematode had been introduced by a too long cultivation of the same soil without necessary treatment to counteract its influence.—Mr. Courthope.

A Beet-pulling Plough at Work in Holland

A German Steam Plough for Harvesting Beets

English v. Continental Farmers.—Taking all these factors into consideration, I venture to think that the results of our experiments are no criterion whatever of what we might legitimately anticipate as an average crop over a series of years. But we do know what has been the average crop in France and Germany, grown by men who have been born and bred to the industry, and who are quite as ready to combine science and practice as are our English farmers. I cannot help thinking it is a little bit of John Bull's conceit to suppose that he could do much better.*

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* Owing to our superior climatic and soil conditions we can grow here a larger tonnage per acre with a greater sugar content in the roots than they can on the Continent.—Mr. Kemp.

If they went through the official figures of the dividends paid in the registered sugar growing companies in Germany last year they would see that just over 30 per cent. was paid on the paid-up capital. They did not expect to do better than that, but if they could pay a fair price to farmers, augment the value of the land in the district which had been opened up, largely increase the head of stock in those districts, and at the same time add to the bearing powers of the land as far as cereals were concerned, he thought they would be satisfied without wishing to do better.—Mr. Courthope.

Reply by Mr. Lloyd: Mr. Courthope mentions 30 per cent. being paid as interest on the paid-up capital. But there are many banks, to say nothing of commercial undertakings, in London to-day paying two or three times that percentage on the paid-up capital, yet no one would for a moment anticipate such a return on a newly started enterprise. These sugar companies were fostered by Bounties and work under Protection, and the factories were brought to perfection probably on profits, not on original capital, and they are now in a position to retain sugar and benefit by the speculations of the sugar market. These speculations and natural causes raised the price of sugar within the last twelve months to £15 per ton. Can Mr. Courthope say how much of that 30 per cent. profit came from actual

Probably the main cause of this mistaken notion is due to the fact that our yields of beet have been recorded in a very rough-and-ready way while the Continental yields are of roots as paid for by the factory. Very few Englishmen have any idea of the great weight of damp earth which will cling to a beetroot. The factory cannot afford to pay for this, cannot even afford to go to the cost of cleaning dirty roots. The roots must be sent to them as clean as possible. Even then by the time they have been scrupulously washed and had rootlets removed, they weigh far less than the farmer would imagine. But this is the weight which the factory pays for, and which indicates the true Continental yield. The writer of the articles in the *Field* has given most valuable information to English farmers on this point, and he is the first to have drawn their attention to this important consideration. It would appear that the factory weight has in some cases been only half the farmer's estimated weight. This is not surprising. Those who have studied the conditions of the industry abroad know that one of the greatest difficulties has always been this difference between the farmer's estimated yield and the sugar factory's return of actual yield of washed roots.*

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manufacturing profit, how much from speculation, and the abnormal price which sugar fetched for some time?

NOTE BY MR. MARTINEAU: My table of the working of the Kruschwitz factory (*see* Appendix), taken at random from the balance sheets of sugar factories in the *Journal des Fabricants de Sucre*, shows that the profit of a German factory can be, and is in most cases, a *bonâ fide* profit on working, not on speculation. Of course, in cases where the working figures are not given, Mr. Lloyd may be right, but the figures when given are a sufficient contradiction.

* Quite right.—MR. MARTINEAU.

I am certain that here in England it would cause many farmers deeply to regret they had ever entered into a contract with the factory; and if any English farmer should take up this culture in the fond belief that he can obtain crops far in excess of his Continental confrères I fear that he will be doomed to sad disappointment.

Crops and Prices.—The average yield of beetroots on the Continent is from 12 to 14 tons per acre. I do not think the English farmer can reasonably expect to obtain a larger crop. At what price he could afford to sell the roots must depend in the first place on the distance of his farm from the factory and the cost of carrying the roots to the factory. This may be comparatively small for the man in close proximity, but for the grower whose farm is situate over two miles from the factory it must be a serious consideration. Supposing that the total cost of carriage, including men, horses, train or boat, is 1s. a ton per mile, we may make the following calculation on a 13-ton factory yield per acre. Roots as sent from farm would weigh, say, 15 tons, and cartage cost 30s.

Price paid by factory at 17s. 6d. per ton on 13 tons	£11	7	6
Carriage	1	10	0
	£9	17	6

What farmer would be satisfied with that price? The fact is that 17s. 6d. a ton for beets may look very tempting on paper. In practice it will not do. Even if we assume that the farmer gets 20s. a ton or £13 per acre for his crop, and that its carriage to the factory costs him 30s., thus leaving £11 10s. per acre for the crop, I doubt whether, taking all things into consideration, it would pay him.*

An able paper on the cultivation of the sugar beet, which appeared in the Board of Agriculture *Journal* for

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* I have spoken with a large number of farmers, and they are all satisfied that if they can get 17s. 6d. per ton, basis 15 per cent. sugar in the root, and 1s. per ton per unit over 15 per cent., they could average over 20s. per ton for their produce, as they contend that with proper cultivation and the right seed they can easily produce roots containing at least 18 per cent. of sugar.—MR. KEMP.

It was a cleaning crop and could be grown in rotation, and as a cleaning crop in rotation they had to compare it not with the most profitable crops that were grown, but with other cleaning crops. How many could show a profit on swedes for feeding? Again, some districts of this country were swede sick and mangel had to take the place of swedes. He had heard from Mr. Stanier, M.P., that in large districts in his neighbourhood where they could not grow swedes, as it was swede-sick, they had to grow mangel and could not get rid of them.—MR. COURTHOPE.

Mr. E. J. Cheney's figures of the production of beet in 1906 on a Suffolk farm showed a net profit of £4 7s. 7d. per acre on the basis of 17s. 6d. per ton for the beet. Was not that a fair return?—DR. SCHACK-SOMMER.

[REPLY BY MR. LLOYD: I have not drawn attention to any of the reputed results of early English growers, simply because they are estimates, and have never been checked by factory weighing, while the few recent crops that have been so checked were painfully unsatisfactory.]

The German farmer had inducements through protective duties to raise grain and other crops which the farmer in Great Britain had not, and his grain crops commanded a higher price. Yet he had evidence that where there were factories willing to contract for increased quantities of beet the farmers in Germany dropped other crops in favour of sugar beet. The particular factory he had in his mind was supplied by some 4200 farmers. It had never paid less than 16s. a ton, nor more than 20s., and the farmers seemed quite content.—DR. SCHACK-SOMMER.

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January, gives the cost of producing a ton of sugar beet in Germany. Taking the average from 1893 to 1898 on ninety-eight farms it was found that the cost per ton was :

On 15 of the farms,	16s. 6d. to 18s. 6d.
On 25 ,,	18s. 6d. to 20s. 6d.
On 22 ,,	20s. 6d. to 22s. 6d.

But what becomes of the factory profit in Mr. Saxon Mills' estimate if instead of 17s. 6d. they have to pay 20s. a ton for the roots, and instead of obtaining their raw material for £29,750 have to pay £34,000 for it ?

The truth of the matter is, that in England we are between Scylla and Charybdis so far as beet sugar production is concerned. On the one hand, a price which would satisfy the farmer for the roots would be prohibitive for a factory, so long as the average price of sugar remains what it has been for some years past. On the other hand, if the factory only paid for its raw material a sum which would permit a small interest on the invested capital, the production of that raw material would entail a loss on the farmer.

Effect on Our Agricultural System.—The production of beets in quantities sufficient to maintain a factory does not merely affect one crop grown by a farmer, it materially changes the whole system of farming. As a rule, the ordinary root crops, mangels or swedes, are abandoned, and this again influences the live stock of the farm. As Mr. Mason says :

> In the economy of the farm it would mean the abandonment of sheep farming, different rotation of crops, an increased head of stock —cattle—to eat the pulp . . . and that we should have to generally adopt methods which the English farmer under present conditions is quite unable to do.

What its effect on dairying would be we can easily imagine, for no one will suppose that the dried exhaust slices could ever take the place of roots for dairy cattle.* But in a country given up to sugar production, where roots cannot be obtained, the farmer is compelled to fall back upon the dried slices as the best substitute available. Hence, presumably, the high price at which they seemed to be valued in such countries—a price which they would, however, never obtain in this country. Is it, then, worth while to decrease our most profitable stock, and probably deteriorate those which are retained, merely for the sake of introducing a new and doubtful industry?

This is not the only change which would be involved. Even Mr. Saxon Mills recognises that it would also involve many vast and serious changes. "We should have to offer high wages to the labourer, and to provide him with new and suitable housing." But he does not solve the problem of where the money is to come from, nor what effect these changes would have in increasing the cost of production of the roots and diminishing the profits to be derived from the industry.

For any country to try to completely revolutionise its agriculture by the introduction of a new industry—the profits from which are extremely problematical, which would have to compete with a similar industry in numerous other countries, and with a closely allied industry on which its own colonies partly depended and which in other countries was making rapid progress—seems to me the height of folly. When the subject was mooted some time ago at the Chamber of Agriculture, I expressed the opinion that it would prove a failure and a farce. Subsequent very careful re-study of the whole question and of all the newest information thereon has strengthened rather than shaken that opinion.*

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* I have seen cows fed on wet pulp mixed with molasses. It was a perfect success. See also Mr. Rider Haggard.—MR. MARTINEAU.

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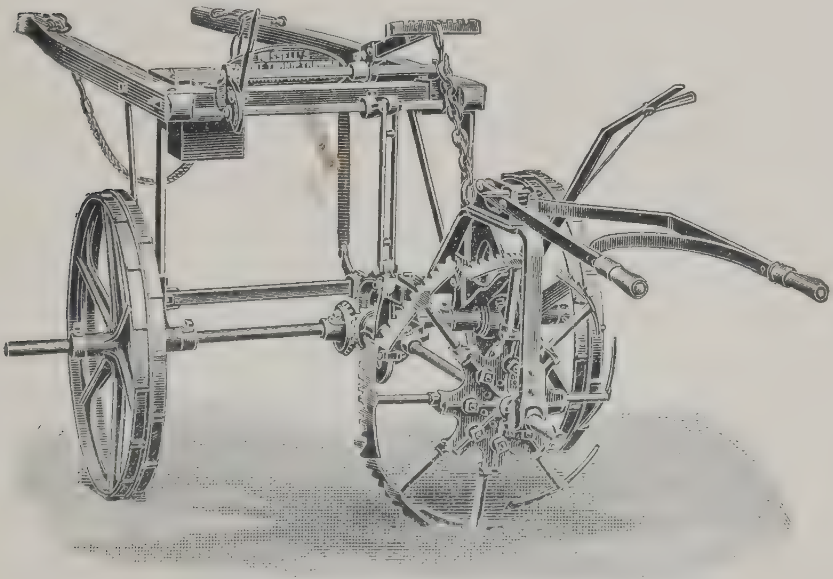
* It is admitted on all sides that Germany is at the zenith of production. Whilst production remains stationary her consumption is going up to such an extent that in under twenty years she will require for her own home consumption almost the whole of the 1,250,000 tons she is at present exporting to us. This means that prices must gradually rise in order to check this increase of consumption, and not only Germany but almost every other country is increasing its consumption. Why, therefore, should not the United Kingdom produce sugar to keep abreast of consumption?—MR. KEMP. [REPLY BY MR. LLOYD: A specious argument, that because we spend so many millions a year on imported sugar we ought to manufacture it ourselves. Look up in "Whitaker" how much we spend annually on imported dairy produce or corn. We know we can produce both of these, why do we not? Simply because it does not pay. Nor would the production of beet sugar.]



AN ENGLISH ROOT THINNER.

CHAPTER XXI

CANE *VERSUS* BEET

"THE makers of beetroot sugar are in advance of the Colonists in having better processes, but that the manufacture of beetroot sugar continues among us at all is owing to accidental circumstances the duration of which is quite uncertain. The planters in the Colonies are already better informed than formerly: an entire revolution in their methods has begun; it is quite inconceivable that they should continue, as hitherto, out of the 20 per cent. of sugar in the cane juice to lose 12 and to gain only 8 per cent. It is for this reason that beetroot sugar has no future to look to."—LIEBIG (1850).

Long Views of Sugar Production.—Seeing that we have been so long in beginning beet growing on commercial lines and in starting factories, we may as well try to take long views of the subject before making an actual commencement. When we come to take long views the outstanding question is, of course, Where is the world going to get its sugar in the future, from the cane or from the beet?

Sugar may be roughly defined as the carbonic acid in the air, plus water, plus sunshine. On the face of it, it may be asked, is it an economical proceeding to seek sugar from a root which has not only to be grown in a northern climate, but to be handled by labour which has to consume a great deal of the sugar produced in order to keep itself warm, when sugar can also be obtained from a plant which grows in hot countries and can have its sugar extracted from it by cheap black labour?

Two questions may also be asked, Does not the sugar cane yield 4 or 5 tons of sugar to the acre to the beet's

$1\frac{1}{2}$ to 2 tons? and, Is not the cane, out of which the sugar is crushed, used up to boil it?

Cane and Beet Figures.—So long as, under the sugar bounties system, beet sugar was prodigally manured with pfennige and centimes, cane might not have a fair chance in Europe. But of recent years it has picked up marvellously. New methods of culture, as well as the latest machinery and the latest sugar science from the beet factories, have done wonders in the cane sugar producing countries. In the statistics for 1909 the world's production of cane sugar is set down at 7,844,000 tons and of beet sugar at 6,651,000 tons. In 1910, owing to the advance of beet, the rivals were neck and neck.

But this is only to account for cane sugar which comes within the range of the statistician. It is what is called the visible production. The real production of cane sugar in the world is very much larger. India is a country in which an enormous production of cane and palm sugars takes place outside statistical computation. As to countries the production of which is known, it is well worth while noting the rate at which that production is increasing.

Cuba, which before the war marketed a million tons, is now getting on for a million and three-quarters. It has been stated that the production of Java, which stands at 1,200,000 tons, will go on increasing at the rate of 60,000 tons a year. The way in which the growing of the visible crop is spread round the world is as follows:

	Tons.		Tons.
America	3,890,000	Africa...	357,000
Asia	3,712,000	Spain	24,000
Australia	291,000		
		Total ...	8,274,000

Spain, like the United States, is a country in which both cane and beet are grown. Beet may also be grown in the future in Australia, South Africa, and Asia. It has been argued that a much larger area is adapted to an economic production of beet than of cane.

Fears in regard to Beet.—Mr. Martineau in his little book has expressed himself as follows:

> A bad season for the growth of beet means a rise in sugar. We are still dependent on the weather which may prevail over a small portion of Europe. When cane sugar has recovered from its partial suppression we need no longer fear the effects of bad weather over a limited European area. The beetroot industry is beginning to get anxious as to its future prospects. Dr. E. O. Von Lippmann, at the head of the German industry, has expressed alarm. He points to the rapid recovery of cane since the Brussels Convention: its monster factories, its large yields of sugar per acre, and, worst of all, its low price of production. He speaks of the cost of production in Cuba being down to 8s. per cwt. f.o.b. He has heard of 6s. 6d. per cwt., and of a factory which produces 78,000 tons of sugar a year. From 1904 to 1909 cane has increased from 48 to 54 per cent. of the world's production. In 1899 cane produced only 31 per cent. . . .
>
> The beet industry shows no sign of reducing its production, but it is quite prepared to face the fact that, all artificial stimulus having been withdrawn, it will not continue to make its accustomed giant strides. M. Sachs, the eminent Belgian expert, says with regard to the rapid increase in the world's consumption of sugar and therefore production: "Europe will take but a feeble part in this increase."

Further, the vehemence of some American beet sugar experts' references to cane planting is calculated to excite a suspicion as to their confidence in the industrial (or political) future of beet sugar being as serene as it might be. Undoubtedly, cane is going ahead, and, it is held, will prevent any permanent increase in the price of sugar, even though Continental consumption is rising. When in 1909 our beet sugar supply from Germany fell short, owing to a short crop, we increased our imports of cane.

Drawbacks of Cane Planting.—A beet sugar manufacturer to whom I read Von Lippmann and Sachs, argued that the

SUGAR CANE, THE RIVAL OF THE SUGAR BEET

cane sugar factories could not in the next ten years make the leap they had made during the last ten years, because they had now availed themselves of the experience, skill, and up-to-date machinery possessed by the beet factories.* Nevertheless, the beet factories would not stand still, and they had the stimulus of working in a bracing climate. The future of sugar making must belong to highly skilled experts and to science, and these advantages were within easier reach in Europe than in the tropics.

Further, black labour was an exceedingly uncertain factor, and would undoubtedly become increasing costly to the cane sugar factories.† I find some information bearing upon this point in the American Department of Agriculture's "Progress of the Beet Sugar Industry in 1909":

> While wages are increasing in this country (the Report has been speaking of the labour supply in the beet sugar industry) the same is true of other (*i.e.* cane) sugar producing countries, notably Cuba. Wages in that island have more than doubled. Ten years ago, labourers imported into Hawaii received from £3 to £3 15s. a month (that is more than many farm labourers are receiving in the county in which I write). They now receive double that amount. The planters' organisation has searched the earth to secure a supply of cheap labour in order to keep down the cost of sugar production. A large part of the cost of sugar production is the cost of labour. The Hawaiian planters have imported Japanese, Russians, and Filipinos. Nevertheless the wage scale gradually rises. The same is true of Porto Rico.

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* PROGRESS IN THE WEST INDIES.—"The most satisfactory feature of all," says the *International Sugar Journal* at the opening of 1911, in a review of the sugar situation in the British West Indies, "is the growing demand for modern mills, and, as even Barbados of late has been largely in the market in this respect, we may conclude that the movement towards scrapping the antiquated plant of a previous generation is well on foot and will progress rapidly towards completion."

† "Cheap black labour is a myth," writes a student of the subject.

It may be mentioned that Cuba, Hawaii, and Porto Rico produce nearly two million and a half tons of the total cane sugar production of the world (8,274,000 tons).

Returning to my beet sugar manufacturer, he made the further point that cane must be handled immediately after cutting, or fermentation sets in. Beet, on the other hand, can be stored for a certain period.

How Beet May Advance.—Then there was always the possibility (the speaker went on) of the sugar content of the beet being raised. Within living memory the sugar content of beet had been raised from 6 per cent. to more than thrice that.

Again, the production per acre might also be increased. In this connection the enormous advance in the production in Russia in 1910 may be noted. Needless to say, the average production for Europe is low compared with what it might be under more skilful and more fully capitalised cultivation.

Improving Beet Seed.—There is hope of progress in cane growing through scientific work with the seedlings, but beet growers are also looking forward to the efforts of agricultural science. One way in which the production per acre might perhaps be increased would be by the success of the experiments which are being made in the United States with a view to evolving "single germ balls." The beet seed like the mangel seed is in a case or ball containing several seeds. Therefore, when a healthy ball is sown, several beets come up close together. To thin them out, leaving one only, means, as they are touching each other, disturbing the seedling which is allowed to remain, and the beet seems particularly sensitive to injury to its mass of hairy roots. The Continental grower goes on his hands and knees to thin, and the uninformed English spectator makes fun of him for doing so, but his object is to do the thinning as carefully as possible. The labour of thinning would be reduced, however, and the plants left in the ground to grow would be saved some disturbance if beet balls containing one seed only could be evolved. Enough has been done by the American experimenters, one reads, "to indicate success"; but the single germ seed will not be available for commercial growing for some years—and of course the Americans may not be on the right track at all. The question of artificially obtained single seeds is discussed in the Appendix.

Material for a Ton of Sugar.—In the long run the competition between beet and cane must be decided by the cost of production. A correspondent of a grocery trade paper wrote during 1910:

> I have seen Java sugar (96 centrifugal) sold for a whole season at a price netting not more than £6 per ton f.o.b. Java. In Cuba the same grade can be produced for less. Against this I have again and again seen the cost of producing 88 per cent. beet sugar placed as high as £8 10s. and £9. One could ship sugar twice round the world for £2 per ton.

I have had the great advantage of discussing this matter of the cost of production with Mr. Martineau. I have also examined a long and searching paper by Mr. Martineau, read a few years ago before a learned society,* in which he argued that cane sugar could be produced more cheaply than beet. He agrees in a letter to me that the present position of cane and beet should be more clearly defined. Some years ago it took 8 tons of beet to make a ton of sugar. Such progress has already been made that, in a good season, 6 tons of beet will make a ton of sugar. The cane sugar industry has also made great progress; what with nine-roller mills, preliminary crushers, double maceration, &c., it now succeeds in extracting 90 per cent. of the juice, and the improved processes of clarification and crystallisation give an increased yield of sugar. Roughly speaking, the best cane sugar factories, working with the best material, obtain about 10 to 12 per cent. of sugar, and the best beet sugar factories, working with beets grown in a good season, obtain about 15 to 17 per cent. of sugar.

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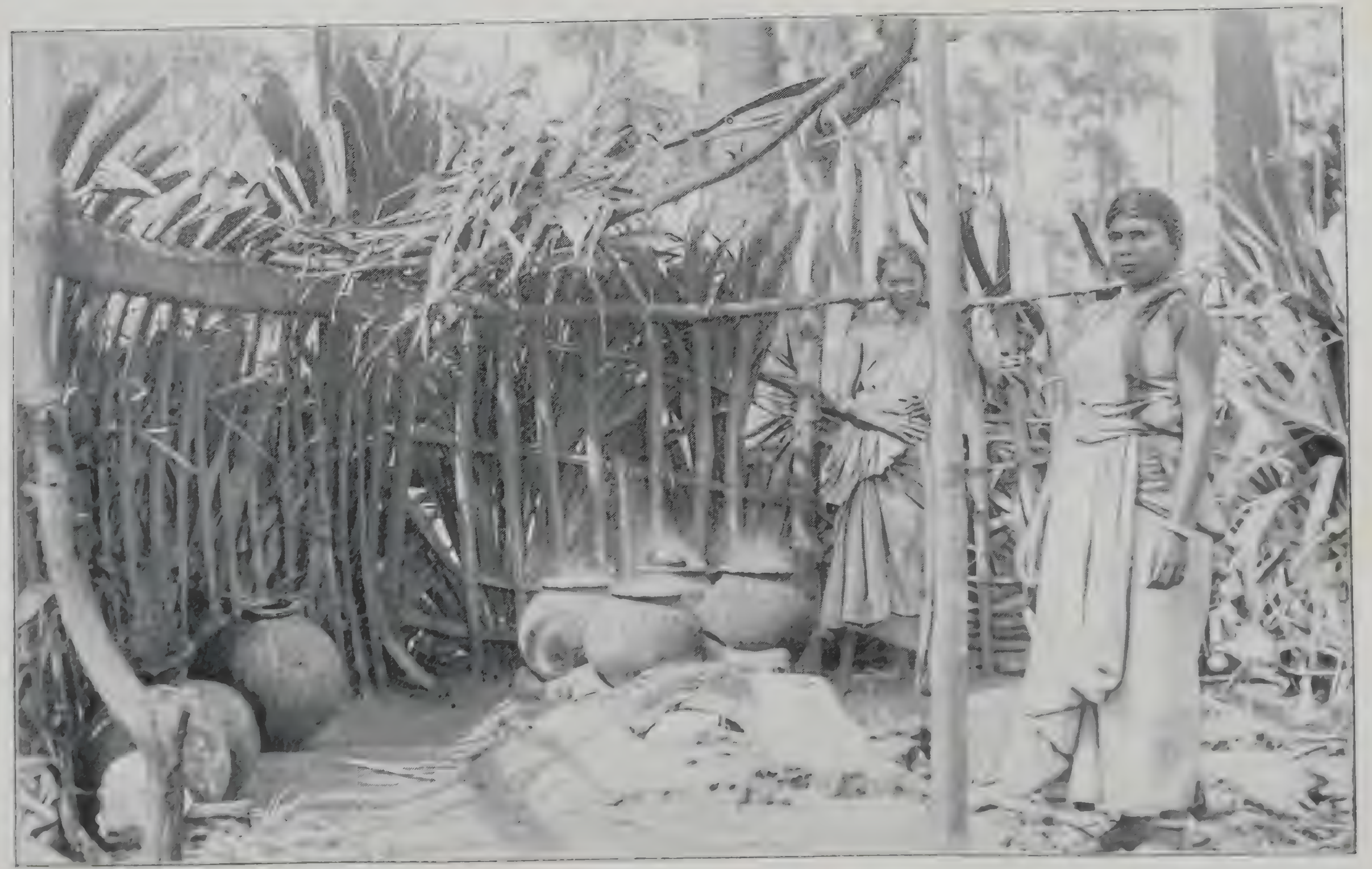
* "The Statistical Aspect of the Sugar Question." Royal Statistical Society's *Journal*, June, 1899.

Cost of Production: Beet.—As to cost, Mr. Martineau's figures of 1899, which have done good service in beet sugar literature, gave for beetroot sugar a cost of production, in the best German factories, of about 9s. 10d. per cwt. of sugar. This was on the 8cwt. of roots to 1cwt. of sugar basis, and assuming that the roots cost 10½d. per cwt., and that the cost of manufacture was 4¼d. per cwt. of roots. It was not long before the yield of sugar from the roots reached 13·5 per cent., or, say, 7·4cwt. of roots to 1cwt. of sugar. But while the cost of manufacture has gone down to 3·89d. per cwt. of roots, the roots cost, to buy, 11·96d. per cwt. So the cost of production is now 9s. 9d. per cwt. of sugar. In considering the cost of manufacture today, Mr. Martineau takes an extremely favourable case. In 1908, beets were remarkably rich and the German factories got nearly 17 per cent. of sugar out of them. Selecting the Kruschwitz factory, he finds 16·64 per cent. of sugar extracted. In such a condition of things only 6cwt. of beets are needed in order to obtain 1cwt. of sugar. The beets cost 21·116s. per ton, or 1·056s. per cwt. The cost of manufacture was 4·355d. per cwt. of roots. Thus the cost of production was 8s. 6d. per cwt. of sugar. Here are the figures:

6cwt. of roots at 1·056s. = 6·34s. per cwt. of sugar.
" " 4·355d. = 2·177s. " "
Total cost of production of 1cwt. of sugar = 8·517s., say 8s. 6d.



"INVISIBLE PRODUCTION" OF SUGAR A SCENE IN INDIA

The sugar, after being boiled, is skimmed. After further boiling, until the point of crystallisation is almost reached, the product is allowed to cool, and the "jaggery" of the sugar trade circulars is ready for the market. Large quantities of sugar, which does not come within the statisticians' figures for "visible production," is made in this way. The old raw Muscovado sugar of the West Indies, as Mr. Martineau explains, was picturesquely manufactured in rows of copper pans, over a great fire, on very much the same lines as the process shown above.

Thus in a good season for rich roots the cost of production has gone down in twelve years 1s. 3d., *i.e.*, from 9s. 9d. to 8s. 6d. a cwt. This low figure is only reached, however, in the very best German factories with the very best roots. For the whole of Europe, Mr. Martineau says, and this should be carefully noted, the figure must be much higher.

The complete figures of the working expenses of the Kruschwitz factory per ton of roots in the campaign of 1908 are as follows:

Roots	21·136s.	Insurance (workmen) ...	·176s.
Coal	1·38s.	Insurance	·092s.
Materials	·53s.	Contributions	·41s.
Lime	·56s.	Depreciation	1·07s.
General expenses ...	·264s.		
Wages...	2·196s.		28·39s.
Repairs	·58s.		

The remark of a beet sugar manufacturer to whom I showed the table was that the items would vary, of course, from year to year.

It must be an error when the cost of producing beet sugar is put by another German authority at about 2s. 7d. for raw sugar and about 3s. for refined sugar, without counting interest, amortisation, and beets.*

As a result, I imagine, of special inquiry in Germany, *Czarnikow's Weekly Price Current*, of December 22, 1910, had some notes which throw an interesting light on the factors influencing the cost of sugar:

> The quality largely influences the cost of production, especially where factories do not grow their own roots, but the weight makes the roots cheaper and the grower more tractable. It is therefore difficult to generalise regarding cost of production; in Germany half the crop is grown by the factories themselves, and the other half must be

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* *See* page 271.

contracted, factories at present bidding M.1 to M.1·10, instead of M.1.25 to M.1.30 last year. The large maker works cheaper than the small man, but everywhere labour, coal, &c., have become dearer, and, when omitting special years like 1908, the working expenses per cwt. roots, instead of 25-35 pfennige, may be put at 35-45 pfennige; therefore if 6¼cwt. roots (yield at 16 per cent.) are required, the cost of producing 1cwt. of sugar is, say, M.1·10 + 40 = 1·50 × 6¼ = 9s. 4½d., plus about 1s. for interest and amortisation. Half of the present crop costs much more, and probably has been sold above present level; but even if the other half can be grown cheaper, we doubt whether on average the next German crop can be contracted and manufactured (on fair yields) at 9s. 6d., if fabricants calculate interest and amortisation. With special quality or weights, and in very large establishments growing their own roots, the cost varies, but if half the crop is cheap, the other half will calculate differently. In Austria the cost of roots may be lower, and the factories expect a slight reduction in sowings. Every 10 pfennige (2s. per ton roots) makes sugar about 7½d. cheaper, whilst every degree more or less in richness again makes a difference of 6d. to 7½d. per cwt. sugar. In France, the factories seem unable to contract roots sufficiently cheap to compete seriously for export at moderate prices.

Mr. Martineau has published a diagram which shows how price fluctuations are the result of visible supply fluctuations. "Thus in 1904," as he writes to me, "there was a deficiency of 1,200,000 tons in the beetroot crop, which made prices rise; then, on the strength of the high prices, they sowed an enormous acreage in 1905 and had a record crop and down went the price. The same thing happened in 1909-10—first short crop and high prices, then big crop and present low prices. The price of sugar still depends on the European beetroot crops."

Cost of Production: Cane.—Now let us turn to the cost of producing cane sugar. As the area in which this commodity is produced is much larger, the cost must vary a good deal. But the cost in the countries in which there has been the most considerable development in the industry has now been defined with some approach to accuracy, Mr. Martineau says: Twelve years ago the figures were as follows:

	Per cwt.
West Indies, Egypt, Queensland, Java, and Hawaii	8s. to 9s. 6d.
Eight estates in Queensland	8s. 3d.
Hawaii (German authority)	8s. 3d.
Egypt	9s. 0d.

In Willett and Gray's *New York Statistical Sugar Trade Journal*, November 3, 1910, a careful estimate of the cost of production in Cuba concludes:

> The average cost of production may be fairly estimated at 8s. 6d. per cwt. f.o.b. Cuba, which we must consider approximately correct, or, say, 9s. 3d. per cwt., landed in the United Kingdom.

The *Journal* statistician takes exception, therefore, to the statement made by Dr. Von Lippmann, and now reproduced from a grocery trade paper, that the cost of producing cane sugar in Cuba is as low as 6s. to 7s. per cwt., say, 6s. 6d.

He adds that "very likely the same increase of costs of Java sugar above 6s. per cwt. may exist for similar reasons." As Mr. Martineau says, it would be very interesting to hear what the average cost of production really is in Java—the annual production in the island is about one million and a quarter tons, or, after Cuba, the largest production from any single country. We are also in need of accurate, up-to-date estimates from other first-class cane sugar countries besides Cuba and Java, Mr. Martineau declares, and there will be general agreement with him that they would be "very valuable at the present moment, when the contest between cane and beet is yearly becoming more intense." As will be seen on page 271, Mr. Geerligs at once responded to this appeal.

A Confession of Faith in the Triumph of Cane.—Mr. R. Harvey, of the well-known firm of sugar machinery engineers, who made some investigations in the West Indies for Mr. Chamberlain before the Sugar Convention, writes:

> Latterly two-thirds of the sugar crop of the world was beet sugar and one-third cane sugar. In a few years the proportion of cane sugar and beet sugar will be reversed—one-third being beet sugar and two-thirds cane sugar. The lowest price at which beet sugar can be produced is 7s. 6d. per cwt., but the average price is 8s. per cwt. actual cost of production, whereas in Java, where there is abundance of labour and well equipped central cane sugar factories, sugar can be produced in some of these factories at an actual cost of 5s. per cwt., and this during a grinding of about four months in the year. In Peru, where there is also a good supply of labour, and where sugar can be made during ten to eleven months of the year, the cost of producing sugar in some factories there, though not at all up to modern requirements, is about 5s. 6d. per cwt. If Peru were fitted with all the latest improvements as regards machinery and up-to-date cultivation, and on a large central factory scale, there is no reason why sugar should not be produced there for 4s. 6d. per cwt. This reveals a great prospect for the sugar cane industry all over the world, so that the production of such sugar in the future will far outstrip the production of beetroot sugar, as in no case and under no conditions can beetroot sugar be produced at the low price at which cane sugar can be made. Even should the Brussels Convention, at any future time, be dissolved, there is no likelihood of any Continental government again burdening themselves and draining their treasury to pay bounties for the exportation of beetroot sugar; it is also very unlikely that the working classes on the Continent, who have at last tasted the benefit of comparatively cheap sugar, will in the future allow themselves to be taxed by dear sugar for the sole benefit of beetroot growers and beetroot sugar manufacturers. It will ultimately come to be a matter of the survival of the fittest if free trade in sugar is made permanent, and, as cane has all along been the natural and cheapest source of supply, there is every reason to suppose that there will be a steady increase all over the world in the production of cane sugar, owing to the low price at which, under favourable conditions, it can be produced.

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Figures from Java.—There could not be a higher authority on cane sugar production than Mr. Prinsen Geerligs, and he has been kind enough to write to me from Amsterdam that he has "carefully calculated the cost of production of Java, and has come to the following conclusion":

> As an average of the results of a great number of Java factories during the crops 1908-9, cost is as follows: Cost of Java refining crystals, basis 96, packed in bags or baskets, and delivered at buyers' doors at coast, including all charges and expenses of management, cultivation, cutting and transporting of cane, manufacture, packing, wear and tear of machinery and buildings, purchase of new machinery, transport to coast, and interest on floating capital, but not including interest on capital invested in sugar houses and plant, amounts to 7s. 6½d. per cwt. For carriage to Europe add cost of handling, lighterage, and freight, so that at a rate of freight at 25s. per ton. the average cost of raw Java sugar, basis 96, delivered at a British port will amount to 8s. 9½d. per cwt.

It will be seen that Mr. Harvey's figures are contradicted. At the risk of bewildering the reader with conflicting data, it is desirable that the extent to which contradictory figures are in circulation on the sugar question should not be ignored.

A correspondent who has been a sugar cane planter writes to me:

> In looking over my old books I find that sugar cane in the raw state in the part where I lived, viz., in the Far East, used to cost, for the first grades, an average of £12 per ton, and was selling at a much higher price in China. This was about fifteen years ago, and if the actual cost price of cane sugar is as low as indicated by certain authorities, why do not all the cane sugar planters find a more remunerative market in China, instead of competing against the beet market in Europe? If the Chinaman can afford to pay up to £16 per ton for raw sugar, surely his consumption will increase at least tenfold when he is offered cane sugar at a reduction of 25 or 30 per cent.? China, as you are no doubt aware, is a huge market, and, therefore, I have no fear of any increase in the production of sugar cane as far as it would affect the European market.

A Difficult Problem.—Business men must draw their own conclusions from the varying figures and facts which I have been able to bring together. The future of cane and beet in competition with one another is certainly not a matter on which too readily to formulate an opinion. It is one of the most interesting but one of the most complicated agricultural and economical problems of the day.

It is clear, as Mr. Martineau said to me, that when cane sugar comes to Europe in competition with beetroot sugar produced on the spot, it has to bear a burden of freight on long voyages and of landing and warehouse charges which home grown sugar would not have to carry.* But these are not the only factors to consider.

Some readers may note the great increase in beet sugar factories in the United States, although it possesses the great cane sugar territories of Cuba, Porto Rico, the Philippines, and Hawaii:

Year.	Acres harvested.	Factories.	Tons produced.
1901	175,000	36	184,000
1908	364,000	62	457,000

But the fiscal advantage enjoyed by American beet planters and by the cane planters of what the United States Government euphemistically calls "contiguous countries," Cuba, Porto Rico, Hawaii, and the Philippines —must be borne in mind. In all the circumstances of the case, the progress of the beet industry there is not so remarkable. It is more to the point to draw attention to the fact that Holland, to which Java belongs, contains 29 beet sugar factories.

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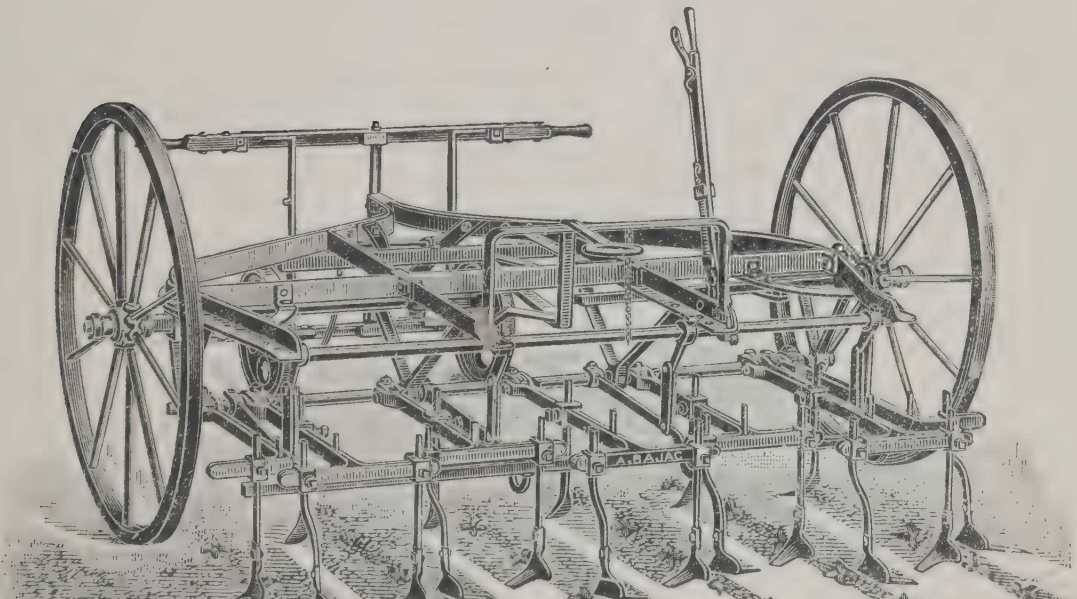
* CHEAP OCEAN TRANSIT.—Too much is sometimes made, however, of the difference between the cost of ocean transport and delivery from the home manufactory to the home market. The most striking illustration is of course in the United States, where the following figures have been published: Sugar rate, Philippines to New York or San Francisco, 24 cents per 100lb. (It has never exceeded 27 cents and has never been below 24 cents.) From the Colorado beet fields to Chicago, 35 cents for 1050 miles.

One thing is plain, it is impossible to consider the future of beet sugar without taking careful account of the strides which cane sugar production is making, the facilities which it is likely to enjoy in the future, and the degree to which the cane interests of the tropics may be able to strengthen their position. The student of the subject will do well to read carefully the remarkable paper in which Mr. Prinsen Geerligs has just described to a meeting of German sugar experts the glowing prospects of cane sugar in Java, Formosa, Cuba, Porto Rico, and the Philippines.



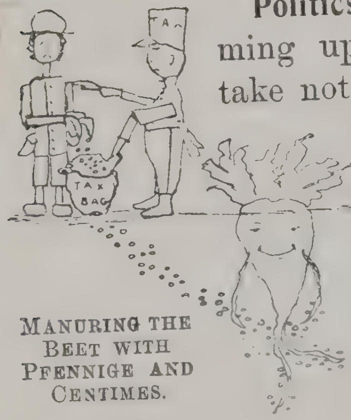
French Beet Hoe.

Used for cutting out by being driven at right angles or obliquely across the rows. It will be seen that this machine is fitted with hoes like our L or angle hoes.

CHAPTER XXII

A NON-PARTY ACCOUNT OF SOME POLITICAL MATTERS

> If history has taught us anything it is that self-reliance and independence and natural liberty are the main conditions on which depend the strength of the State, the prosperity of the community, and the greatness of nations.—Viscount Goschen.



Manuring the Beet with Pfennige and Centimes.

Politics.—Before proceeding to a final summing up, it is unfortunately necessary to take note of some matters on which a great deal of party ink has been spilt. I shall do my best, by confining myself, as far as practicable, to statements of fact and to references to authorities on both sides, to present an impartial account of the Bounties, the Convention, and the Duties. But it is no easy task. Those who, with a modicum of knowledge, examine at all attentively what has been said and written on these subjects must be "astounded," as an expert has declared, "at the cross-purposes and crooked answers that abound." Much that has been printed is based on information of a superficial character, and is distorted by party bias. And the views of the two camps are always sweeping. From one side in the controversy I hear that "Mr Martineau is a most untrustworthy guide"; from the other that "Mr. Mathieson is an especial sinner!" A pamphlet I refer to is declared by one side to be "not worth mentioning," and by the other to be "most excellent and conclusive." After this, the reader, duly warned, must look after himself!

How the Sugar Bounties Worked.—As has been explained in Chapter III., Continental Governments had given their beet sugar manufacturers quite remarkable assistance. In Germany, for instance, writes Mr. Martineau in his book:

> The consumption duty, that is the duty actually paid by the consumer, was 10s. per cwt; but the import duty, that is the duty which anyone outside would have to pay in order to enter into competition, was 20s. per cwt., just double. The surtax on imports, was therefore, 10s. per cwt. and, within the limits of this large amount, the home producer could raise his price to the consumer without fear of outside competition.

The whole German industry combined in what was called a "cartel":

> The great glut of sugar was rapidly increased, but the profit in the home market was so large that they could afford to sell their surplus for what it would fetch and yet make an abnormal profit on their total out-turn. The value of sugar in the world's markets fell 3s. per cwt. below the cost of production,* but the German producers were delighted, declaring that the proper policy was to keep prices down so as to crush all outside competition.† This was regarded with dismay. not only by the ordinary unaided producer,‡ but also by the rest of the beet root industry itself, which had long enjoyed and still retained the smaller benefits so generously bestowed upon them by their paternal Governments.

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* *See* Appendix.

† That is, competition by other beet growing countries than Germany and by cane sugar.

‡ The cane sugar producing Colonies and the refining trade in England.

The Case for the Convention.—We in England, then, had cheap sugar, the cheapest in the world, for we alone among nations had no import duty. What was there to worry about? In the opinion of very many people, nothing. "The effect of a foreign bounty must be," said Mr. Balfour, and the Liberals agreed with him, "to benefit the consumer in this country."*

But the voice of the producers of raw sugar in the West Indies and of the refiners in Great Britain was heard. The planters had been badly hit, and refiners in Great Britain had to bear the competition of cheap refined sugar from the Continent. To both classes Mr. Chamberlain addressed himself bluntly:

> The policy which this country has been applying for many years (he said in 1881) is to prefer the large consuming interests of the whole community to the small producing interest of any single class. . . . It is to the interest of the sugar consuming public to have raw and refined sugar cheap; it is to the interest of the English sugar refiners to have raw sugar cheap and refined sugar dear, and it is to the interest of the West India sugar growers to have raw sugar dear.

The time came during his Colonial Secretaryship when he changed his views.† His position now was that our cane-growing Colonies must be protected, that there could be no security in trades based on or related to a commodity admittedly sold to us below the cost of production, and that the cane sugar industry, not only of our own Colonies,

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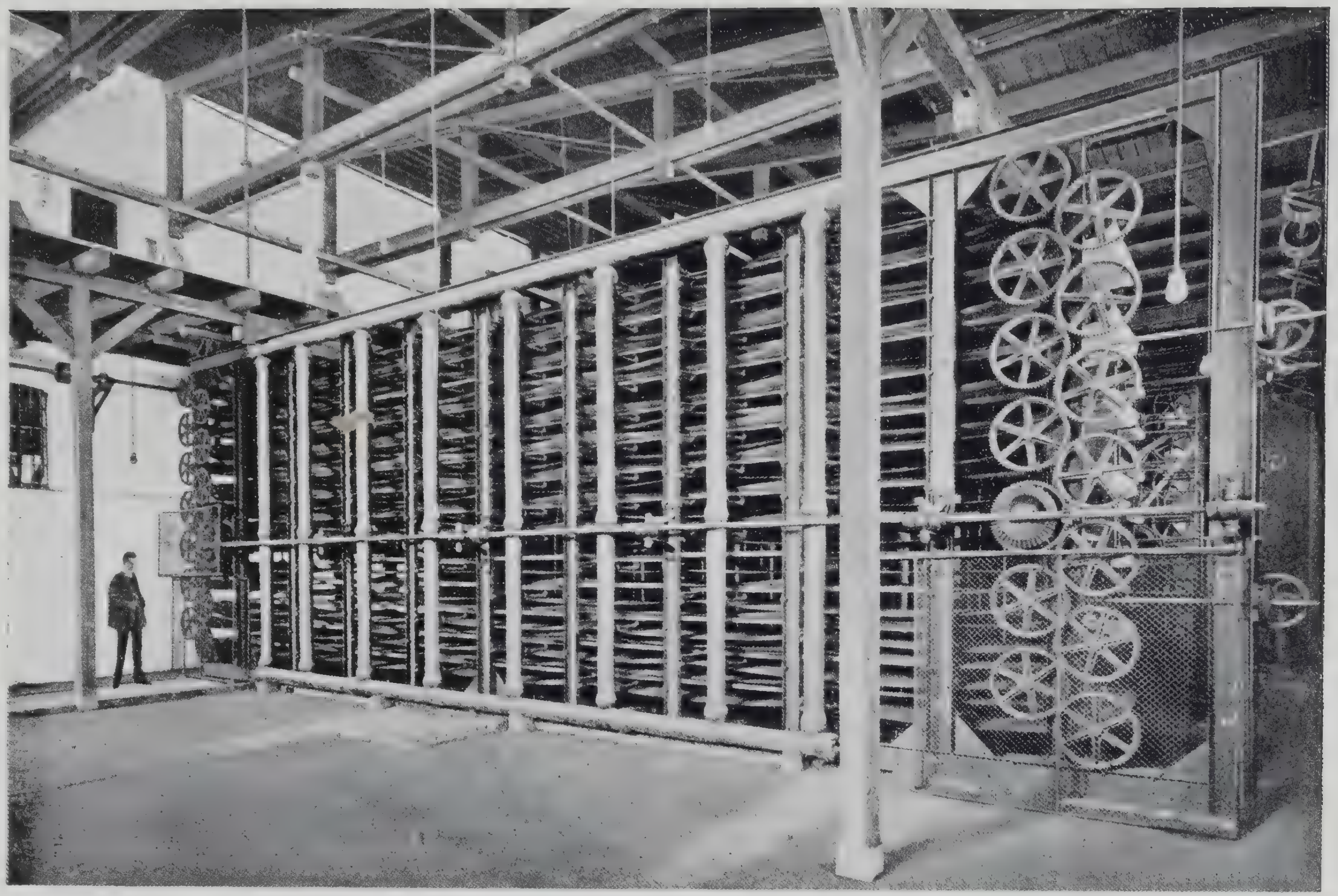
* It is only fair to note that in another speech Mr. Balfour argued that the sale of an article below cost price is not a benefit but an injury to the consumer, because it deprives him of the benefits of free competition, reduces his supplies, and gets him into the meshes of a monopoly.

† *See* his speech on the Indian Tariff Bill, 1899.



Beet Seed Drying Apparatus at Klein-Wanzleben

but of Java and Cuba, was in danger from the low price to which the cartels had forced and meant to force sugar, and that, in fact, the world was likely to become dependent on beet alone for its sugar supply. The impartial chronicler must note that the accuracy of all these statements was vehemently denied and is still denied by his critics.*

The Convention.—From 1862 onwards, International Conference after Conference had been held between Continental countries, who were paying the bounties and feeling the effects, and Great Britain, whose consumers were receiving cheap sugar. At length, in 1887, a Convention was signed, but not ratified. By 1896 the chief beet growing countries were closely engaged in putting up their bounties against one another: the war of bounties was being carried to the bitter end. In 1901 the Brussels Conference assembled which produced in 1902 the famous Convention.†

Its Scope.—It came into force in September, 1903, and it was arranged that it should remain in operation for five years.[*] It abolished bounties given on export, on production, by exemption from taxation, or in any other way, and enacted that the import duty on refined sugar imposed by the signatory Governments must not be higher by more than 2s. 6d. per cwt. than the excise duty levied on home-produced sugar. The idea was that, at that figure, there was no room to form a cartel to raise the price to the consumer. "Subsequent experience has shown," however, Mr. Martineau states, "that half the surtax suffices to keep out competition."

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* *See* chapter "The Wrong and the Right Way with the West Indies" in Mr. G. H. Perris's "Case against the Convention"; and, *passim*, Mr. J. M. Hutcheson's "Notes on the Sugar Industry in the United Kingdom" ("Countries like Java, much more distant than the West Indies, have been able, and generally without bounties to aid them, to send us a much larger percentage of our sugar"); publications of the Cobden Club; Mr. G. Mathieson's leaflets ("It was not bounties that injured West Indies production, it was inefficiency"); and the *Sugar Users' Journal*. In 1909 the total quantity of sugar imported into the United Kingdom for home consumption was 1,637,896 tons. Of this only 61,056 tons came from the British West Indies and the only other sugar imported from British possessions, *i.e.*, British India, the Straits Settlements, and Mauritius, amounted to 24,148 tons.

† In 1902, Mr. Balfour's Government was in power and Mr. Chamberlain was at the Colonial office.

Duties Imposed by Continental Powers.—The present situation is that the Continental sugar maker pays his excise duty whatever it is, and he has what advantage he can get from the difference between it and his country's import duty, which must not be more than half-a-crown above the excise duty. The Powers signatory to the Convention were Great Britain, France, Holland, Belgium, Germany, Austria-Hungary, Italy, and Sweden.[†] Since the year 1903, therefore, the Continental countries have been unable to give more than half-a-crown of Protection. The United States is outside the Convention, and its sugar makers are able to get the world's price for their sugar, plus 7s. per cwt., the amount of the American import duty. Holland is the only country which has no surtax. She has an excise duty, paid alike by home products and foreign imports.[‡]

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[*] A year's notice to withdraw must be given, *i.e.*, on September 1, 1912, because of extension in 1908.—*See* p. 280.

[†] Luxemburg, Peru, Switzerland, and Russia joined afterwards.

[‡] Mr Martineau has kindly given me the detailed figures for France and Germany: The French import duty on sugar not above 98 per cent. yield is 25fr. per 100k., plus 5fr. 50 = 30fr. 50. On sugar above 98 per cent. yield it is 25fr. plus 6fr. = 31fr. They are really 2fr. above these figures, because there is 2fr. *taxe de raffinage*, which is merely a polite way of raising the sugar duty by 2fr. The

Imposition and Reduction of our Sugar Duty.—Up to 1901, two years before the Convention, we had, as has been explained, no sugar duty at all. Sugar came into our ports free. But the sugar duties which had formerly existed were re-imposed (on an entirely different principle) in 1901 (April 18), by Sir Michael Hicks-Beach (Lord St. Aldwyn) as a means of meeting the expenses of the Boer War, *i.e.*, as a "financial necessity" tax. In 1904 Lord St. Aldwyn expressed surprise that Mr. Austen Chamberlain, his successor at the Exchequer, should need to retain the war tax on sugar. In 1908 (May 18) the duty, which was 4s. 2d. per cwt. for pure sugar, was reduced by Mr. Lloyd George to a maximum of 1s. 10d.[*]

How we are in the Convention but not of it.—The same year the renewal of the Convention was due. It was not to be expected that the Liberals, who had attacked the

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excise is the duty minus the 5fr. 50 and 6fr. respectively. The German excise duty is 14 marks per 100k. on all sugar, raw or refined. The *droit d'entrée* (import duty) on all sugar which receives no bounty is "fixed in accordance with the maximum stipulated by the Convention and for the duration of the Covention; that is—Refined, 14 marks plus 4m. 80 = 18m. 80 per 100k.; raw, 14 marks plus 4m. 40 = 18m. 40 per 100k.

[*] Incidence of the Duty.—1s. 10d. is the duty on sugar of 100 per cent. polarisation. (*See* Appendix). Java and Cuba centrifugals (raw cane sugar) have a polarisation of 96 and pay 1s. 7d., while 88 per cent. raw beet sugar has a polarisation of 94 to 94½ and pays 1s. 6d.

The Sugar Tax.—Mr R. M. Leonard says the nation has paid in all £52,000,000 in sugar tax. (*See* Appendix.) Writing on the reduction of the duties in 1909, the *Economist* said: "A sum of more than three millions sterling has been added to the purchasing power of the people, which will be fructified in innumerable ways to the advantage of innumerable industries."

The question of the import duty is further discussed in Chapter XXV.

Convention as against Free Trade, would take the same view of the duty of renewal as their predecessors would have done. There was a penal clause in the Convention by which countries maintaining a bounty were to have their sugar penalised by having their customers' import duties increased against them by the amount of the bounty, and the new Ministry decided not to renew the signature of Great Britain except on its own terms.

It accordingly proceeded blandly to inform the other signatory Powers that it was about to admit the bounty-fed sugar, against competition with which in our market the Continental Powers thought they had in 1902 secured an undertaking. The Continental Powers were aghast at the "perfidy," for their chief object in promoting the Convention had been to put an end to the bounty war for the English market, from which they all suffered. But the British Government was firm. Only by being relieved from the undertaking to penalise bounty-fed sugar would Great Britain re-sign the Convention.*

The Penalising Powers.—The Continental Powers had to give way. They did not want to start a bounty war again, and, under pressure, Russia, which had been bounty-feeding her sugar, was, by an ingenious compromise, gravely admitted to the fold of the Convention. She was allowed to be a signatory on condition that she did not export to the whole of Europe more than 200,000 tons a year. Finland and Turkey, however, were not reckoned Europe, and she might make unlimited exports to Persia or to any other Eastern country.

All European countries signatory to the Convention but Great Britain go on levying a countervailing duty on bounty-fed sugar. At the moment of writing, these countries are keeping an eye on Japan. Some parts of the world narrowly escape being dealt with under the Convention. Cuba sends her sugar where she will, because the fiscal advantage her manufacturers enjoy is not her own act. It arises from the preference given her by the United States.* If the Americans themselves exported (raw sugar produced in the United States), they would have to pay for their bounty of 7s. per cwt. (which arises from the admission of their own sugar free from the the duty of that amount) by being countervailed. As their advantage can only be obtained in their own market they do not export. If they were to produce more sugar than they could themselves consume and were then to export, their sugar would have to face the penal clause in the country of every signatory to the Convention except Great Britain, which, as has been explained, has relieved herself of the obligation to impose a penal duty.

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* Additional Act, signed at Brussels, August. 1908. It extends the Convention for five years from September 1, 1908.

Why We Remain in the Convention.—Why did not the Liberal Government simply denounce the Convention, instead of remaining a nominal signatory? Sir Edward Grey explained in 1908 that it was one thing not to have entered into the Convention and another thing to denounce the Convention on the faith of which other nations had made arrangements. Continental countries represented that Great Britain had taken a leading part in getting them to enter the Convention, and that they had been at great trouble to remodel their fiscal systems. They were certainly prepared to carry on the Convention without Great Britain; and, had we stayed outside the Convention, they would probably have put retaliatory duties on our sugar products. Such duties would have been represented to be no violation of the most-favoured-nation clause.

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* Cuba is reducing her import duty (which is quite an empty formality, since an island which produces 1,800,000 tons and consumes 50,000 is not likely to want to import) in order to come under the 6 francs rule of the Convention, and thus avoid being countervailed.

> We have never yet come to the position (said the Foreign Secretary) that another country has definitely imposed heavier duties on British goods than any others. If that time ever comes it is only within reason to conclude that it must have an adverse effect upon our political relations with other countries.

"The real objection to the Convention," Sir Edward Grey went on, "was the penal clause":

> We were one country, one consumer, with a number of producers in the majority, who might form a ring and outvote us, and might oblige us to close our ports, first to one country and then to another. We might be able one year to import sugar from Brazil; the next year it might be decided that Brazil gave a bounty. It was to the producing countries' interests to put the widest construction on bounties and to our interest to put the narrowest. Under the modified Convention we cannot be asked to close our ports at any time.*

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* THE CASE AGAINST THE CONVENTION.—The views of those opposed to the Convention are thus stated in the *Sugar Users' Journal* (March, 1910): "Statistics quoted by Mr. George Mathieson in the *Times* show indisputably that there has been an actual decrease (notably in the British West Indian Colonies) in the production of cane sugar since the Convention came into force in countries affected by it. The increase has been wholly in countries where neither European bounties nor the Convention have had any influence, and that increase would equally have taken place had there been no Convention. European beet sugar has also increased, the result doubtless of decreased excise duties in most countries.

"Another allegation is that the Convention has not merely prevented sugar being at famine prices, but has actually made it cheaper. Six years have elapsed since the Convention came into operation (September, 1903), and as the Convention year, when 88 per cent.

The Question of an Excise Duty.—As we have no sugar factories, only refineries of the raw sugar which other countries have manufactured, we have no excise duty, only the import duty of 1s. 10d. With regard to an excise duty, in case a sugar beet industry were established here, Lord Denbigh wrote on March 28, 1910

> The Government admits that so long as the import duty on sugar is at its present figure—below 2s. 6d. per cwt.—there is no obligation on us under the Brussels Convention to impose an excise duty. They also state that legislation would be required before an excise duty could be imposed. This is because in the Finance Act of 1901, imposing an import duty on sugar, no mention is made of any sugar except that which is imported, since all sugar was, and is still, imported.
>
> The Government contend, however, that the concluding words of Clause 2 of the Sugar Convention Act, 1903, compel the imposition of excise duty, though this contention seems inconsistent with the statement that fresh legislation would be required to carry this out. The clause states : "The duties payable under the Finance Act, 1901, or any Act amending that Act, shall be taken on the delivery of any

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beet sugar f.o.b. Hamburg (the quality always taken for statistical purposes) averaged 8s. 3d. per cwt., might be assumed to vitiate a comparison, we will not reckon that year. The average price for this class of sugar for the six years ending 1902 was 9s. 1d.; for the six years ending 1909, 10s. The figures are those of Messrs. Czarnikow."

The *Sugar Users' Journal* (February, 1911) says: "With an increasing population an increased consumption of sugar ought to follow as a matter of course. But a comparison between 1901, when the tax was re-imposed, and 1910, shows not merely a proportionate, but an actual decrease.

	1901.		1910.
"Population of the U.K.	41,971,827	...	45,554,866
Sugar imported	1,732,199 tons.		1,728,730 tons.

"Had sugar been left alone by Parliament it is difficult to imagine such a result.

"The latest figures published by the *Produce Markets' Review* relating to the consumption in the principal countries of Europe which article from the factory or refinery, and shall be the same as those payable on the like articles on importation."

I have already pointed out that the Finance Act, 1901, deals only with import duties so far as sugar is concerned, therefore it is difficult to understand how any obligation to impose an excise duty can be interpreted thereby. This point requires to be satisfactorily cleared up.

Ministerial Statements.—The following month (April 5th) Lord Denman made the following statement on behalf of the Government:

Under the Sugar Convention Act, 1903, we are under a legal obligation to impose a duty on sugar manufactured from home-grown

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are parties to the Brussels Convention, for the past ten months of the sugar year—September to June—are worth placing on record:

Country.	1909-10 Tons.	1908-9 Tons.	Tons.
France (refined)	507,550	500,181	+ 7,369
Germany (raw)	1,014,694	987,818	+ 26,876
Austria-Hungary (raw)	486,356	474,707	+ 11,649
Belgium (white)	75,931	72,447	+ 3,484
Holland (raw)	92,046	89,390	+ 2,656
United Kingdom (raw)	1,423.298	1,513,573	– 90.275

The British decrease far exceeds the increase in the other five countries put together.

"Let us look at this increase in the Continental consumption of sugar in another way—our authority the Statistical Abstract (Cd. 5053)—expressed in *metric* tons of 1000 kilogs. = 2204lb. first in the year 1902-3 before the Convention came into force, and in 1908-9 the first year of its continuation as at present.

Country.	1902-3	1908-9
Russia	733,620	959,700
Holland	72,198	112,000
Belgium	60,000	112,000
France	371,119	682,000
Germany	730,748	1,263,000
Austria-Hungary	431,764	581,000

Beet Seed Storehouse at Klein-Wanzleben

beet, but there is no legal power to do so without legislation. The clause is not very clearly drawn. It might be intended to refer only to imported sugar, but it might also be held to include any sugar going out of a factory.

A week later Sir Edward Grey, answering a question in the House of Commons, admitted that under the Convention it was open to the Government to differentiate between home-grown and other sugars within the limit of 2s. 6d. per cwt. of refined sugar, but by the final protocol to the

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See also "The Sugar Convention, Its Cost and Consequences," by Mr. Mathieson, and "The Sugar Duty and the Brussels Convention," by Mr. Perris.

THE CASE FOR THE CONVENTION.—For the sugar trade statistics on which the case for the Convention was based and for a statement of the case, see Mr. Martineau's long paper in the *Journal of the Royal Statistical Society*, June, 1899 ("showing how remarkably the production went up in proportion with the rise of the bounties, and how the French production stood still for years with no bounty, while the German progressed by leaps and bounds with a progressive bounty"); his article, "Free Trade in Danger," *New Liberal Review*, November, 1902, and Chapters IX., X., and XI. of his manual, "Sugar: Cane and Beet, an Object Lesson." The provisions of the Convention are summarised by Mr. Martineau in the *Economic Journal*, March, 1904. "Seven Years of the Sugar Convention, 1903-10," by Mr. R. T. Hinckes, is described as "a vindication of Mr. Chamberlain's policy."

Mr. George Martineau writes: "When, as in 1910, a drought causes a shortage of 1,200,000 tons of sugar and a great rise in price, it is misleading the public to tell them that the price of sugar has gone up because the bounties were abolished. In point of fact, it went down. Why? Simply because there was too much sugar. When the drought came it went up. Why? Simply because there was too little sugar.

"When a great rise in the price of sugar occurs, the people of this country work on "invisible supplies," which causes an apparent reduction in visible consumption. See the following figures:

U.K. visible consumption, September to February—

6 months	1910-11	....	836,253 tons.
6 „	1909-10	....	876,271 „

Convention the Government had declared that no preference could be given to Colonial sugar as against sugar from the contracting States.*

> He did not, however, throw any light (said the *International Sugar Journal*) on the Government's professed inability to suspend the excise duty. Neither did Mr. McKinnon Wood, who answered a similar question a few days later. The Government apparently claim that though the Convention does not prohibit a preference in favour of home-grown sugar, they are debarred from granting it owing to a clause in the Sugar Convention Act of 1903.

A German View. — The following comment by *Die Deutsche Zuckerindustrie* (March 11, 1910), may also be reproduced:

> We always say that in no way can there be deduced from the wording of the Brussels Convention any obligation for England to renounce the surtax laid down in Article III. of this Convention in case beet sugar should be produced in England, *i.e.*, to impose upon home-grown sugar an excise duty of the same value as the entrance duty. If, however, the English law officers of the Crown agree with the revenue authorities and should read such an obligation out of the instructions for carrying out the so-called Sugar Convention Act of August, 1903, it can only be profitable for us.

The Actual Benefits Derived from the Bounties.—In addition to the benefits claimed for the Convention, it was hailed as removing a great obstacle in the way of establishing a beet sugar industry in this country. As to the precise value of those bounties, in the long run, to the European nations which enjoyed the luxury of them, opinions notoriously differ. Certainly in 1908, when the Convention had to be renewed, no country showed any wish to abandon it and revert to the bounty system. An undoubted authority on the sugar question, in a letter which I have had the opportunity of reading, writes:

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* Mr Martineau writes: "If some future Government gives preference to home grown sugar it must give the same to our Colonial sugar. To do that it must get the ridiculous proviso in the final protocol of the Convention cancelled."

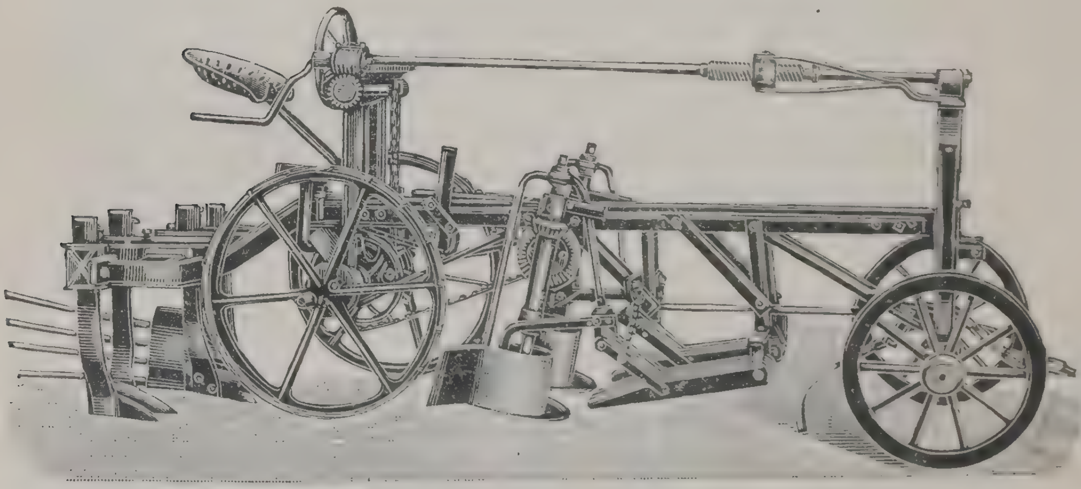
> Knowing as I do the whole history of the sugar bounties, I very much question whether, in the long run, they were of any benefit whatever to the sugar grower, because they soon over-produced sugar to an extent which more than fed the home consumption, and the surplus had to be exported to England at a loss. Since the abolition they have done fairly well. Many German factories are extremely prosperous and the French do pretty well.

No one questions the fact that the sheltered circumstances in which sugar beet manufacture began had something to do with the industry getting a hold. But how much was due to those circumstances and how much to the other circumstances summarised at the end of Chapter III. has not yet been satisfactorily determined. As the authority just quoted continues:

> Of course, with the Continental system of agriculture, sugar cannot be taken by itself. It is a part of the rotation of crops, and, now that wheat is so much dearer, we may expect that there will be no large fresh extension of cultivation. The reason why beet sugar has not been taken up here is that since the days of Arthur Young, some century and a quarter ago, we have had a rotation of crops in England, the place of sugar beet being taken by turnips and mangels. The Germans and French started with a three years' fallow. The result of the introduction of sugar beet into those countries has been that land which used to be useless every third year has come into cultivation. The deep ploughing necessary for the beet and the chemical manures for it have increased the yield of corn, while the refuse beet, by feeding cattle, has led to an enormous increase in the herds in France and Germany. Sugar does not therefore stand by itself, but must be taken as part of the whole farming system.

As to the present fiscal situation on the Continent, Mr. Sigmund Stein has expressed the opinion that "although the Continental sugar countries have on paper a protective duty of 2s. 6d. per cwt. of refined sugar, they have in fact, owing to the keen competition between the manufacturers in the home market, not a single penny of Protection and advantage. On the other hand, Mr. Martineau writes to me that

> the Austrian refiners have formed a small cartel in order to exploit the 2s. 6d. surtax, and have been most successful. They have raised the price of refined sugar in Austria very appreciably, as I have shown. That is why I say with confidence, as you have quoted, that half the surtax suffices to keep out competition. Germany shows no sign of following suit, but she may have a try. This must be remedied in 1913.
>
> I do not agree that 2s. 6d. a cwt. protection has enabled any country except Austria (and France) to raise the price to the consumer to any appreciable extent. Austria has done it by successfully running a refined sugar cartel. France does it by having a very reduced production which enables them to squeeze the consumer—the 2s. 6d. being just sufficient to keep out foreign competition.
>
> But the 2s. 6d. would be very useful to the infant industry in the United Kingdom, because, as we are supplied entirely by imports, the home grower of beet sugar will always get the market price, plus 2s. 6d.



A German Implement for Raising Two Rows of Beets and Topping Them.

CHAPTER XXIII

THE PROSPECT: FOR THE FARMER

Quality of English Beets.—We may now conclude from what has been done on experimental plots, and from the experience of growing for the Dutch factories undertaken in 1910, that *in large areas in England and Ireland, when the farmers concerned have had the requisite experience, sugar beet may be grown to a sugar percentage and no doubt to a weight equal to the average produced on the Continent. Those areas have yet to be more closely defined, however, and the possibilities of growing crops, satisfactory alike to our farmers and to our factories, on other than the best land on the farm, have yet to be examined.** It is known that beet is grown on all sorts of soils on the Continent. But there are some factors operating in the agricultural economy of the Continent which do not operate here.

The advocates of a beet sugar industry in this country, or many of them, are not content, however, with beet crops equal to those produced on the Continent. They say we should and can do better. Figures as to sugar percentage and weight which are plainly absurd have been printed, and are still being printed. As to tonnage, quite late in the day it has dawned on some of the authors of this kind of statistic that the Continental averages are for washed weights, that the factories pay on the weights of scrubbed roots only. But enthusiasm, untempered by real acquaintance with Continental experience, still leads to no little exaggeration as to weights.*

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* Professor Malpeaux, who is Director of the Agricultural School of the Pas de Calais, suggests that in France "it is desirable to confine the production of beet to the best soils in order to get the maximum results, and to grow other things capable of taking their place in the rotations." "The difficulty," he adds pathetically, "is to find among these last any that are remunerative."

"To secure a good tonnage of high grade beets requires a fertile soil, well worked."—Secretary American Beet Sugar Association.

English Weights.—More than 14 tons an acre of sugar beet washed weight may have been produced *in agricultural conditions* in this country, that is, in areas of more than an acre at a time; but in the spring of 1911 indisputable evidence of the fact was not forthcoming. In this book only one absolutely unquestionable 14 tons crop and only one 12 tons crop are recorded as having been raised in 1910. Several growers grew 10 tons and a little more, but the Hollandia average was not quite 8 tons, washed weights, and the Arnhem average, of "clean" not washed weights, was no more than 9½ tons.† These crops suffered from the drawback of—

Unprepared ground,
Late and imperfect sowing,
Inexperienced and inattentive thinning and hoeing, and
Unskilled or careless harvesting.

That the average weights obtained in spite of these drawbacks excited surprise by their lowness is only to be regarded as further evidence of the general unacquaintance with (1) the conditions in which, after several generations' experience, good crops are raised on the Continent, and (2) the actual weight of those crops.

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* For example, a London paper of the day on which I read this in proof says: "Some (experimental) plots produced between 20 and 30 tons to the acre. Since 10 tons is sufficient to meet the expenditure, there should be some remarkable profits when," &c.

† The sugar percentage of the 14 tons crop was 15 per cent. The highest sugar percentage was 16·05, but the crop in this case was only 9·6 tons.

Continental Weights.—It can never be sufficiently emphasised that the Continental average over the latest ten years' period is only 10·4 tons. That is for Holland, Belgium, France, Germany, Denmark, Sweden, Austria-Hungary, and Russia. If we leave out Austria-Hungary and Russia, as the countries farthest away from us and the producers of the poorest crops (though the second and third largest in total weight), the Continental average is only 11·3 tons. Holland, which is the hot gospeller of sugar beet in this country, produces herself only 10·6 tons (about the same as Sweden, 10·9); Germany and France, which have been longest at the business, only 11·8 and 11·2 tons respectively; and Denmark, to the agricultural methods of which our attention is so often invited, only 11 tons. Belgium, the home of intense culture, has the highest average of all, but it is only 12·1 tons.

The 14,700 acres which produced 190,000 tons in Hesse in 1910, yielded an average of 13 tons only. The great Kruschwitz factory's report in respect of its total tonnage in six figures, handled during the last two years, is that it was produced at an average rate of from 10 to 10¼ tons.

It may be added that the United States crop of 1908-9 was only a little over 8 tons against the Continent's 11 tons.*

The Possibilities of Finer Crops.—It is unnecessary to say that the average crop in every beet growing country is brought down by a certain amount of poor land and starved culture.* It is possible to argue, therefore, that in England, with good land and liberal treatment, and our acknowledged skill in root culture—"Look at what our men have done with potatoes in Lincolnshire," Mr. Strutt once said to me — the crops may be expected to be equal to those produced by the best Continental farmers on the best Continental land.† But beet growing, which is an advance on ordinary mangel growing, surely needs learning?‡ Is it for nothing that Continental beet growers have all the hereditary knowledge of the crop they possess? One who has studied the beet sugar question for a long time, and knows our agricultural conditions, long since impressed on me the fact that from a beet-growing point of view we have an uneducated rural population. "It must take us several years," he said, "to acquire the necessary skill to compete on equal terms with the Germans and Dutch." Why does Mr. Cohen, in dealing with farmers as skilful as those of Norfolk, bring over Hollanders to do their beet seeding and hoeing?

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* "At various points in the beet growing States the factories are experiencing great difficulty in obtaining a sufficiently large crop. The greatest dissatisfaction has arisen on the question of tareing."—"The Story of Sugar." By G. T. SURFACE, Ph.D., 1910.

An Austrian agriculturist now in England, who has a taste for the minutiæ of agricultural account-keeping, thinks that 14 tons would be an "exceedingly good" crop in England. Mr. Stein, Mr. Cohen, and the Maidstone delegates to Magdeburg believe that 15 tons washed weights can be grown here; Lord Denbigh and the agent

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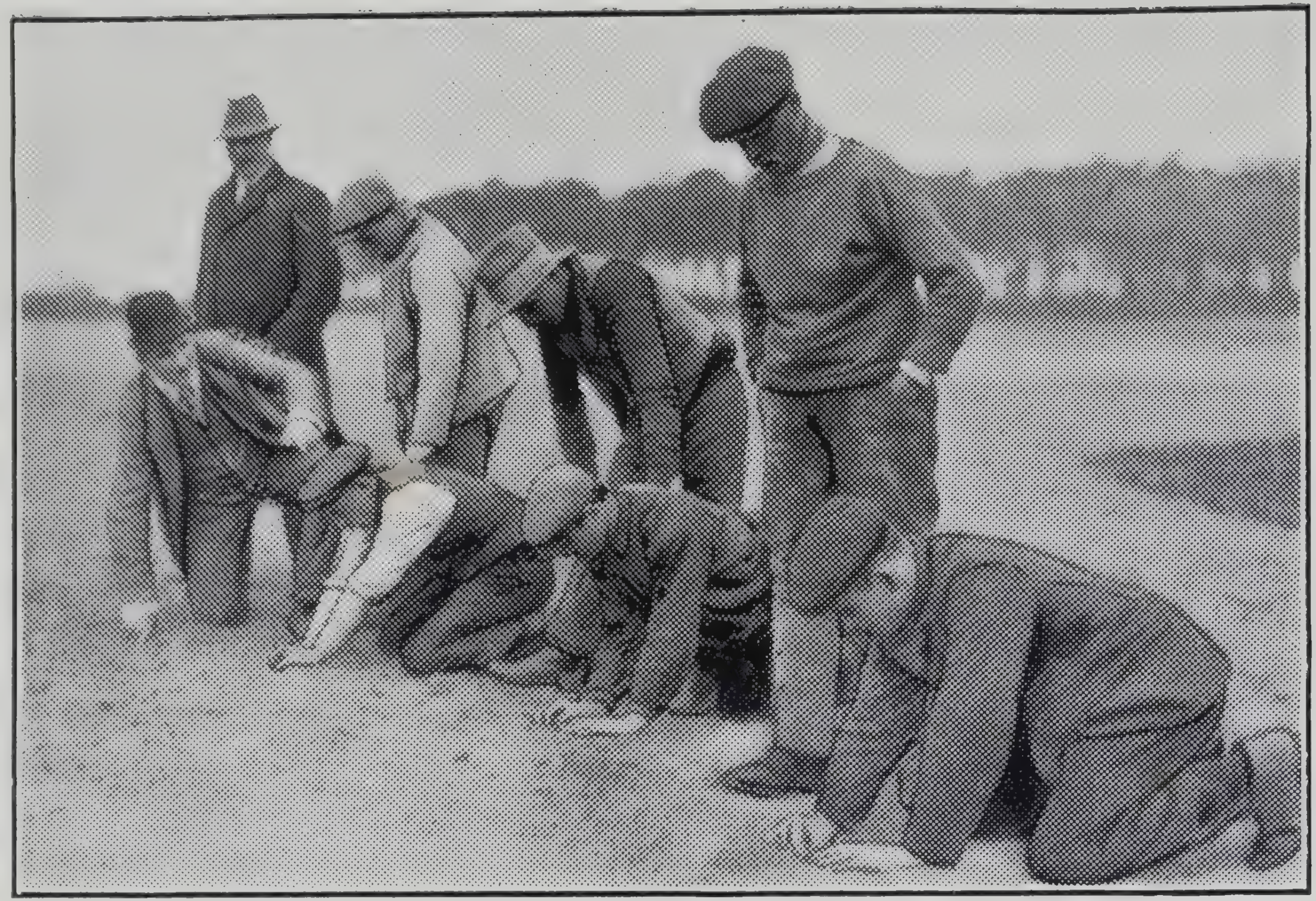
* "Twenty-five years ago natural beet soils were selected to produce the commercial crop, whereas, nowadays, a large percentage of the beet area consists of generally poor soils and even marshy, peaty soils."—Report of Wohanka Seed Breeding Station, Prague.

† The statistical average for the United Kingdom of four quarters of wheat does not affect the fact that thousands of farmers grow five.

‡ "Quite true," pencils a German correspondent on a proof; "but your farmers don't think so."



Suffolk Labourers Singling Beet with Dutch Instructors

There are parts of England in which the men already go on their knees to single roots

of the Hollandia Company* speak of 15½ and 16 tons respectively. In the prospectus of the defunct Sleaford factory scheme 17 tons figured. But read the experience of the Westphalian farmer quoted by Mr. A. O. T. Bennett, in the *Farmer and Stockbreeder :*

> My friend grew an average crop of 13 tons in 1882-92. The percentage of sugar, however, was only 11 to 14 per cent Now he grows a smaller crop of roots, but the sugar per cent. is from 15 to 19 per cent. The highest yield on his best field was 19½ tons ; the yield on his best acre of land was 23¼ tons. But as the latter contained only 9 per cent. of sugar he did not send them to the factory, but fed them off at home. It now pays better to produce less weight per acre and have a higher percentage of sugar.

This is, of course, because the factories pay not by the ton only, but take into account the sugar percentage. Mr. Bennett was talking early in 1911 with four gentlemen from Saxony, and one of them told him that he grew 13 tons an acre of beets in 1910 and was "very satisfied." Yet his land is in "about the best beet growing district in Germany."

If beets are to be bought by English factories, as no doubt they will be eventually, by sugar percentage and weight, is it not possible that we may have some discoveries to make as to the relation of big yields to sugar content? This is one of the points on which further information seems to be necessary.†

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* Mr. Petitpierre retired from the East Anglia Co. on July 1, 1911.

† WEIGHT *v.* VALUE.—In 1910, in the United States the beet acreage and yield were considerably less than in 1909, but "the companies in a majority of the States will have a profitable campaign because the beets, except in a few instances, were unusually rich in sugar." In Canada there was in 1910 a decrease of beets worked of 26,725 tons, but "the beets yielded 12·41 per cent. of sugar this year, against 11·79 last year." As long ago as 1900, Mr. A. D. Hall told the

I hope to see 15 tons, as I believe Mr. A. D. Hall, Director of Rothamsted, does too, and if it is possible to grow more with a remunerative sugar percentage, I hope to see that. But *it is necessary to emphasise the difference not only between particular crops and average crops, but between quantity and quality.* As to the ability merely to grow a weight of roots there can be no doubt. Two of the most skilful and most trustworthy East Anglian agriculturists I know both assure me that they feel quite able to grow 20 or 30 tons, *if it is desirable to do so.* But it is a duty to point out that, *at the time of writing, there is no evidence that* 15 *tons have been grown in this country;* though, no doubt, crops of a greater relative weight than that have been produced on small areas. We may have, and I count on seeing during 1911, much larger crops than were grown in East Anglia in 1910, but it is hardly wise to argue too far in advance of facts.* And even when we have the 1911 figures it will be necessary to ask if average farmers will get as good crops as those which are being raised in Norfolk in favourable circumstances this year.

"It is often the case," says the *American Beet Growers' Annual*, "that in attempts to introduce the industry very extravagant statements are made by interested parties as to the probable yields. The

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British Association that "the results obtained in Belgium and the United States, where the climatic conditions closely resemble our own, warn us not to expect any serious appreciation of crop that is not accompanied by a diminution of sugar content."

On the other hand, the American representative of Messrs. Wohanka and Co. says he has seen a field in California "yielding during two successive years 35 and 33 tons of beets per acre with 19 per cent of sugar and 90 per cent. of purity."

* Mr W. E. Sawyer, who has closely studied the Norfolk crops, writes to me (May 20, 1911): "Most emphatically we cannot grow 15 tons per acre. On some good land we may, but that is not averaging 15 tons."

statement that the yield is 20 to 25 tons per acre, is generally far too extravagant, for experience teaches, both in Europe and in America, that 12 to 15 tons may reasonably be expected, and with such a tonnage the industry is inviting for both the grower and manufacturer. While the yield often falls below 12 tons it also often rises above 15, even to 25. But such results are not common, and it is unwise to encourage farmers to figure on such a high basis."

Even this statement is too positive, for the writer, when he speaks of from 12 to 15 tons being "inviting," is speaking of American conditions, and in the United States beet sugar production goes on agreeably behind tariff walls of 7s. a cwt. on beet sugar!

Putting aside averages for the whole country what do good farmers just across the Channel obtain?

Good cultivators (says an excellent authority, Professor Malpeaux) do not exceed on the average a return of from 12 to 14 tons per acre, and in dry years they reach from 11 to 12 tons with difficulty. In exceptional places and in favourable years the crop rises nearly to 15 tons and even to 16 tons, but these results are only got in rich, deep earth, such as is to be found in the Cambrésis and round about Valenciennes. In 1905 the crops ran up as follows:

Nord	nearly 13 tons.
Seine et Marne	about 12½ ,,
Oise, Aisne, and Seine et Oise	over 9 ,,
Somme	nearly 9 ,,

We Should go on Growing Beet.—Meantime two Continental correspondents intimately associated with the East Anglian experiments of 1910 write to me as below. One says:

It must be borne in mind that last year's experiments were carried out with a view of finding out what quality of beets could be grown in England on a large scale, and the yield per acre was never in question. It was a mistake, therefore, to dwell on and to emphasise the question of yield as has been done by many. The quality of the beets grown on a commercial scale has been found excellent, and this should be quite enough encouragement to go on making further experiments to find out what yield can be got under best conditions.

The other correspondent expresses himself as follows:

> After a first year, which after all was only to find out if beet could be grown, the experiments should be continued with warmth. The first year is naturally not appropriate to find out how much beet can be got. This will require several years. These experiments must be made now while the exceptional chance still offers that there are those willing to take the roots. Such experiments will be too late if the farmer waits till there is a factory in England.

The question of the yield per acre is therefore something to be discovered in the future. Indeed, in the opinion of one particularly interested in hastening matters, after "*several years*'" work.

There is, however, no reasonable doubt in my mind, nor in the mind of any careful student of the subject, that *beet of the right weights, that is the weights most profitable to the farmer and the factory, can be grown in this country.*

Attitude of Farmers.—The next question is: Will they be grown? The discouragement of the Essex farmers after one season's experience—whether these dour folk were handled as judiciously as they might have been must be regarded as an open question—and the resignation of the Essex directors from the directorate of the Anglo-Dutch Company,* are a symptom which it is foolish not to face frankly. "I have taken little interest in the beet sugar question of late," writes to me from another county than Essex a correspondent, who was ready to be a large subscriber to a well-considered factory scheme, "as I quite despair of anything being done. The farmers everywhere are indifferent, too unenterprising to learn how the crops should be grown, and quite content to go on in the old groove." In a note I have from a great authority on the sugar question I read: "The farmers will not respond to the appeal to grow beet because farming now pays well. We must wait for bad times." It is evidence of the attitude of many farmers towards a new crop that some of them told the Hollandia Company naïvely that they "would give the beet a better field next time." Evidently they felt that anything was good enough for the first year's crop!

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* The Company retains an option on the Maldon site.

It is certainly not because of the financial position of farmers that they will be loath to experiment. It is very possible, indeed, that if agriculture were not so successful as it was shown to be in that convincing "Pilgrimage of English Farming" in the *Times*, farmers might be more willing to alter their rotations. The wit who was asked if he had a mind to lend a friend a guinea, replied that he had the mind but not the guinea. In the case of the farmer and sugar beet the fact seems to be that he has the guinea but not a strong enough inclination to lay it out in putting down land to the new crop. It is not the means he lacks, but a different attitude of mind.

He needs to be convinced, no doubt, that sugar beet would pay him. But it is not his lack of knowledge of the new crop which may be pressed against him as an offence. Those who do not know may learn if they have the right attitude of mind. The point is rather, Has the class of farmer whom it would be necessary to get to take up beet growing, if a sugar beet industry is to be a success, the disposition closely to study the needs of the new crop, that is to go to school to "foreigners"? Farmers have learnt before, and they can learn very well. They are always learning. As to this sugar beet business, the very mangel wurzel, kohl rabi, and swedes, that some will have it stand in the way of the new crop, have been accepted from the Continent, and have in their time revolutionised our farming. But it is impossible entirely to forget a story I heard of the East Anglia Company's handbook. It was first entitled, "Instructions to Farmers." It was found expedient to alter its name to "Hints on Cultivation"!

One thing is quite certain. Successful beet culture is largely a matter of attention to small details which our farmers cannot be acquainted with without learning. It is within the knowledge of one resident in Germany that when beet-growing was started in California "a good many" young Germans, who were earning about £40 a year, got billets on the Pacific Slope at about £150 to give instruction in the new culture. The Americans clearly went the right way about making their new departure in farming a success. Great credit is undoubtedly due to Mr. Cohen and to the Hollandia Co. for importing practical beet workers from Holland into Norfolk and Suffolk this year.

The No-Room-for-Beet Argument.—"Some of our very conservative agriculturists say," writes Lord Denbigh, "that there is no room for this extra crop in England, entirely forgetting the four and a half million acres that should be arable and at present are under grass."

Even assuming that it is desirable that all those four and a half million acres should be put under the plough,* the problem of getting them under cultivation will be no nearer solution if the farmer is unconvinced that sugar beet is a desirable crop to grow.

The Labour Problem.—Those who have spoken with many farmers as to the possibility of their growing beets have found that it is usually the labour problem of which they are most afraid.* It is not only a question of getting the labour but of housing the labour. In discussing beet growing, we are back once more to the cottage question, to which, in co-operation with Mr. St. Loë Strachey, I endeavoured to draw attention in "In Search of a £150 Cottage," the sequel of which was the first Cheap Cottage Exhibition at Letchworth.

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* VACANT LAND.—A correspondent says, "The reply is surely that the grass land suits the requirements of dairy farmers at present, that dairy farming increases owing to the demand for milk, that in many cases the grass land is poor land, and that we do not want poor land for beet."

Labour is needed in "making the beets" as well as in lifting them. It may be suggested, of course, that of late years large areas of England have been turned into potato and green pea fields, which call for no end of labour, and that it has been forthcoming. Again, would labour difficulties in any case become acute at once? Farmers are asked to contract for beets for a few years ahead; but there is no need for them to contract immediately for all the acreage they may well be prepared later on to put under beets if they find that labour difficulties can be surmounted. No doubt the more enterprising farmers, who are the class most likely to take up beet growing, will also gradually avail themselves of implements for lifting and otherwise dealing with the crop of the kind which are in use on the Continent.

It has been suggested that gangs of men and perhaps women might be brought down to the beet fields from the towns in the same way that hop-pickers are organised. But the task of picking hops from a handful of bine at a profitable rate is, though it needs learning, a very different thing from using a hoe. Hoeing calls for skill, and, as the "natural" said, when, by a hard-pressed farmer's assurance that it was "a new kind of game," he was led to try potato-lifting, "it's perlish like wark." In any case the analogy between beet and potatoes hardly holds good, for these crops are often sold to buyers who bring down their own gangs.

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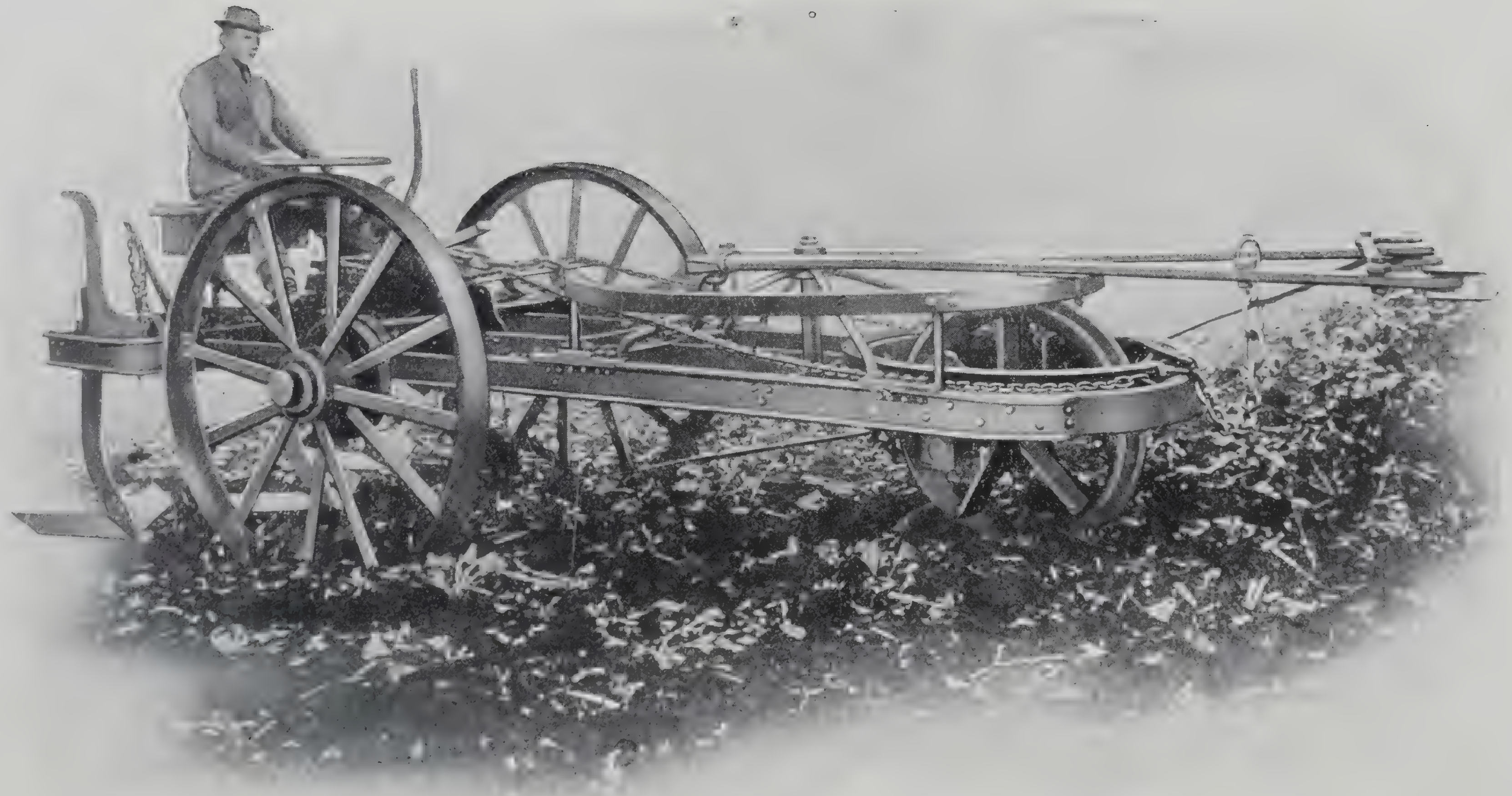
* "The serious problems facing the sugar beet industry to-day," one reads in a United States Senate paper, "are (1) How to secure a satisfactory supply of labour; (2) How to maintain and extend beet culture in competition with farm crops."

American beet farmers are greatly worried by their labour gangs, and the English beet-grower may expect to have his troubles too when, for the Polish and Galician summer labourers, who do the beet work of Germany and Denmark, he tries to make shift with out-o'-works. As Mr. Bennett writes to me: "The sugar beet is a delicate plant in its first stages and has to be treated as such; you can't turn a lot of men into the fields with hoes and let them slash about as they do with mangels."

The Cost per Acre.—*What the cost of the crop per acre will be in England over a term of years is not yet definitely known.* The average of all the East Anglian estimates I have been able to obtain is £10 10s. 6d. at the station, or at a factory within the distance most farms are from a station. The average of available Anglo-German and French and German estimates is £11 15s. (Both these estimates include rent, rates, and taxes.) We must take these estimates for what they are worth only. As to experimental crops, the cost can never be the cost in working conditions. But it will be noted that the current estimate of £10 as the cost of an acre of beet is exceeded, and that the cost of the crop on the Continent sometimes works out at more as well as less than English estimates. We have undoubtedly some low-rented beet land, but Mr. Strutt thinks 25s. is too low (page 145); and rents are not falling. The figures of so high an authority as Dr. O. Rabbethge go up to very high sums. No doubt these are the



AN ENGLISH BEETROOT LIFTER AT WORK IN GERMANY

Like the foreign machines, it loosens the beets and slightly lifts them, leaving them in such a condition that they can remain in the ground for a week, and can then be easily removed by hand without the use of hand implements. A variety of points is supplied to suit different conditions of soil. The machine is steered between the rows, each tine lifting two rows. Four to ten row machines are made data of good land, where crops are heavy—mangel costs more in some parts of England than others—but those who talk a little airily of confining beet culture to the best land in this country should be reminded that in some cases the cost will be high.

A Factory Area.—As to the payment for the crop, the farmers who are nearest the factory will get the best price. The farmers who are farther away will have carriage to meet. It is possible that a factory may be able to secure a sufficient acreage of beets within a 2s. a ton railway rate radius. It is safer, perhaps, to assume a half-crown radius for a proportion of its beets.

Few people realise the area of land required to support a big factory. Suppose 4500 acres of beet to be wanted. Then, with a four-course rotation, the farmers of at least 18,000 acres of arable land must be growing the crop. Assuming there is no grass land on the farms, this means an area of some 28 square miles, or, say, a tract nearly six miles by five miles. With the usual proportion of grass land the area might be doubled. As it is unlikely, however, that any farmer will grow more than from 10 to 30 acres each, the required 4500 acres would have to be spread over from 150 to 450 separate farms. (As at the beginning of the beet growing, at any rate, farmers will grow roots as well as beets, the probabilities are that the beet area would in practice come out of the white straw area.) But will so compact a beet growing area be easily got? Our farmers notoriously pride themselves on their individualistic farming. They have not the Continental habit of co-operating to produce large quantities of the same crop. Some will go in for beet; their neighbours will resolutely refuse to do so. The first factories in England will probably have to go thirty or forty miles for some of their beet.

Price per Ton.—In 1910 the best offer was 20s. a ton and possible extras. That may be all right at the factory, or for farmers who are within a mile or two, and can deliver their beets at the factory at a cost not much in excess of the expense of putting mangels into carts, clamping the roots, and then carting them out of the clamps to the stock.*

But 20s. may mean 19s., 18s., or even 17s. 6d., for farmers at a distance. It is suggested that the price should be 20s. at the nearest station or wharf, because the German factories, taking one year with another, pay that. (There is some evidence that they do a little more.) It is also suggested that if the Dutch factories can afford to add transport across the North Sea to the 17s. to 18s. f.o.r. they paid East Anglian growers last year, an English factory should be able to pay quite 20s. There is obviously something in this, and also in the fact that in 1910 Dutch factories were buying beets in Germany at a 4s. advance on what the German factories could pay.† But those who know something of sugar factory working and the sugar business understand that it may pay a factory to give a special price for beets by way of supplementing its supply, and so allowing it, at a comparatively small increase of expenditure, to go on producing sugar some days longer than it would otherwise be able to do.

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* It has to be borne in mind, however, how much slower a business throwing beets into a cart is than tossing mangels. A man cannot pick up more than two or perhaps three at a time with his hands. But with a ball-tined fork and the knack, beets can be moved about as quickly as mangels. Eight, ten, or twelve roots can be got on the fork.

† A Free Trader would no doubt suggest that Holland is practically a Free Trade country while Germany is a Protectionist one, and some expenditure may therefore be lower in Holland.

‡ Nearly 140,000 tons of beets were bought from Germany.

Further, the Dutch factories were no doubt prepared to spend some money to make a manufacturing test of English beets, and to peg out claims here. I believe that the Dutch manufacturers have a map in which their spheres of influence within the Netherlands have all been carefully delimited. Are they now taking the first steps towards a partition of our Eastern Counties?

Mr. Cohen has this spring gone one better than any previous offer by promising, on behalf of his prospective Norfolk factory, 21s. 6d. delivered at the factory, or 20s. at the station. (For Maidstone rates, *see* page 317.)

The accompanying table shows how the farmer will come off at varying payments for his beets. It is to be borne in mind that he gets no return whatever for the railway carriage he pays on the dirt attached to the roots. The practice of some German factories in this matter is worth notice.

Income Per Acre, at Varying Payments Per Ton, as Against an Outlay of Ten or Eleven Guineas (Average of Estimates in Chap. XIII).

Weight of crop per acre	Value per ton at different rates (washed weights).									
	17s.	17s. 6d.	18s.	18s. 6d.	19s.	19s. 6d.	20s.	20s. 6d.	21s.	21s. 6d.
Tns.	£ s.	£ s. d.	£ s.	£ s. d.	£ s.	£ s. d.	£	£ s. d.	£ s.	£ s. d.
7	5 19	6 2 6	6 6	6 9 6	6 13	6 16 6	7	7 3 6	7 7	7 10 6
8	6 16	7 0 0	7 4	7 8 0	7 12	7 16 0	8	8 4 0	8 8	8 12 0
9	7 13	7 17 0	8 2	8 6 6	8 11	8 15 0	9	9 4 6	9 9	9 13 6
10	8 10	8 15 0	9 0	9 5 0	9 10	9 15 0	10	10 5 0	10 10	10 15 0
11	9 7	9 12 6	9 18	10 3 6	10 9	10 14 6	11	11 5 6	11 11	11 16 6
12	10 4	10 10 0	10 16	11 2 0	11 8	11 14 0	12	12 6 0	12 12	12 18 0
13	11 1	11 7 6	11 14	12 0 6	12 7	12 13 6	13	13 6 6	13 13	13 19 6
14	11 18	12 5 0	12 12	12 19 0	13 6	13 13 0	14	14 7 0	14 14	15 1 0
15	12 15	13 2 6	13 10	13 17 6	14 5	14 12 0	15	15 7 6	15 15	16 2 6
16	13 12	14 0 0	14 8	14 16 0	15 4	15 12 0	16	16 8 0	16 16	17 4 0
17	14 9	14 17 6	15 6	15 14 6	16 3	16 11 0	17	17 8 6	17 17	18 5 6

+ Value of unexhausted manures (?) and deep culture (?) + Leaves and tops (£1) + Allowance of wet slices (3s.) + Lime, &c. (?) + Bonus (?) + Dividend (?).

Along with the table it is of interest to print the following which reaches me from Dr. Rabbethge:

> The average price for beets paid by the German factories in 1910-11 was about 22s. per ton.
>
> The distance the beets are generally transported to the factory is a little over three miles.*

Wages and Machinery.—Whatever may be the case in Holland, where I never found rural wages very different from what are paid in Essex, it is difficult to believe that some German field labour is not less expensive than English is likely to be.† For one thing, a great deal of female and child labour is notoriously employed.‡ Fifty or sixty children may be found singling together under a ganger. The schools, in fact, give holidays to suit beet culture.§ As to women, one sees them in almost every photograph of beet cultivation and harvesting. But women do not work in the fields everywhere in Germany. The women in the pictures are usually foreigners. It is easy to generalise in an unsatisfactory way about Germany. We should think of the difference between, say, Essex and Cumberland farming, and then remember that Germany is just four times the size of England.

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* ADVANTAGES OF GERMAN GROWERS.—On the Hanover-Cassel line one sees a factory almost at every station. The factories are certainly not more than ten or fifteen miles apart. Also it should be borne in mind that there are low railway rates in Germany. *See* Appendix. A French writer attributes German superiority in the sugar beet business to cheaper manual labour, higher average production of roots, higher sugar percentage, and lower freights to London—5s. 10d. from Hamburg, as against 12s. 6d. from Paris.

† There are large Austrian beet farms where harvest wages are only 1s., or a little over, a day.

‡ Much Polish and Galician female labour is by no means cheap.

§ In several parts of England holidays are already arranged so that the children may work for the farmers.

Here is a description of the best way to single beets, given by Güterdirector a. D. O. Kreuz-Weidenhof: "If children are to be had, let the grown-ups hoe across the rows with hoes 6in. wide, leaving bunches of 1in. to 2in. in width. Behind them follow the children, who leave single plants at a distance of 8in. to 9in. (This is sufficient with the rows 14in. apart.) If no children are to be had, let the men do the work their own way. After hoeing for the last time, use a machine to cover up the tops."

There are high wages as well as low wages in Germany. While there are low rents there are also high rents. Again, the best beet growers do a much larger amount of work to their beets than is generally imagined in this country. Look for confirmation of this at the details of the year's operations disclosed in several beet growers' balance sheets. In going into beet growing English farmers are undoubtedly undertaking the production of a crop which needs very high cultivation. Is it likely, however, that the substantial English farmers, who already so fully appreciate the value of up-to-date implements and machinery, will be disposed to place large areas under beet without availing themselves of the mechanical advantages offered by the best Continental and American experience adapted to our own agricultural conditions—that is to say, steam cultivation, efficient mechanical hoeing, and the best crop-raising contrivances driven by steam or petrol power?* Experience in this country and across the Channel, the North Sea, and the Atlantic, has clearly demonstrated the advantage the agriculturist who uses the best modern methods has over the old-fashioned grower dependent on hand labour, or on an elementary form of horse labour. It is only by means of machinery and good land and culture, not by means of cheap labour, that the cost per acre can be cut down in this country. The sugar beet industry can have no welcome here as a cheap labour industry.

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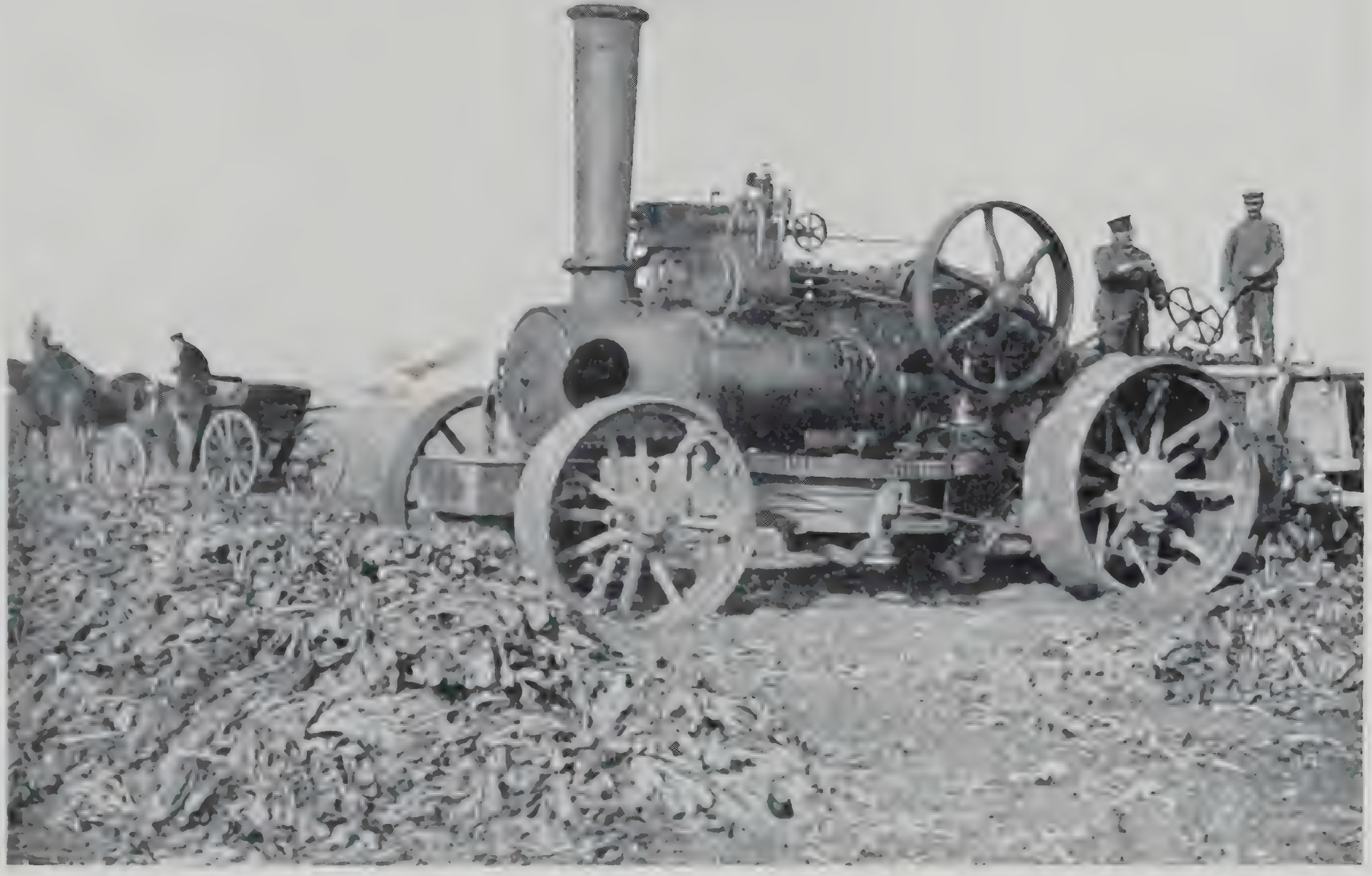
* MACHINE HARVESTING.—It has been calculated in France that 10s. an acre can be saved by machine harvesting owing to the roots not being broken off. When well built, carefully regulated, and well driven, says an authority, the beets can be harvested intact. There is a machine in France which goes beyond loosening the beets in the earth ready for hand removal. It extracts them, beheads them, shakes them, and throws them in a row. In easy working soils and good weather the machine is said to answer very well, but whether the expense is wholly recouped has been questioned.

But no Continental expert believes that the best machines will obviate the necessity for a great deal of handwork, which, if it is to result in first-class crops, must be patiently and well done. Is it possible to rely on getting this properly done? Is there a certainty that children will be forthcoming to do much? In our rural districts, as in Holland, do not women work less and less in the fields? Mr. Cohen has been recommending the crop this year by his enterprising importation of ingeniously contrived machines, but some years' experience will be necessary before we can learn just how much *hand labour* beets can do without and pay for growing *in England.* A German correspondent writes to me: "You will never get a real crop without plenty of hand labour." On the labour question the following extract from a letter in the *Westminster Gazette* from its Berlin correspondent (April 26, 1911) may well be pondered:

> Every spring the organs of the Agrarian party start an animated discussion concerning the famine in agricultural labour. In Prussia alone 309,000 foreign labourers were engaged in agriculture in 1908. Yet complaints were heard of rotting crops. Both thoughtful Germans and mere hunters of cheap labour are dissatisfied with the system. If a great war were to break out, it is admitted that German agriculture would be doubly paralysed. by the withdrawal of the native Reservists and the drying up of the Austrian and Russian immigrant supply. The Russo-Japanese war alone made trouble in Prussian agriculture, and even the Balkan crisis of 1909 caused



One of a Pair of Engines Engaged in Drawing a Beet Harvesting Machine near Magdeburg

Beet tops in the foreground

difficulty in recruiting Galician labour. A champion of Agrarian interests half-seriously proposes the recruiting of Asiatic labour on indenture conditions. "The German Field-Workers' Bureau" recruits labour abroad and on the frontier. But, despite their excellent organisation and help from the police, the landowners cannot get a reliable supply of labourers during the busy seasons.

The confidence expressed in Kent by fruit and hop growers and in Essex by green pea growers as to labour being forthcoming for beet, if there is good pay and organisation, must carry great weight and is good to hear. But the opinions formed by agriculturists in other counties on the subject should also be taken account of.

The Real Return.—When the price per ton which the factories will be able to pay, and the value of the leaves and tops of the beet, and of the bonuses, slices, and lime which the beet grower is to put to his credit, are all in some doubt, it is plainly an unsatisfactory business to estimate the probable return per acre.

Obviously, a considerable proportion of that return must be in kind: there will be so much in leaves and tops ploughed in or fed to stock, so much in lime, so much in cheap pulp, so much in unexhausted manures, so much in added value to the land by reason of deep cultivation and thorough cleaning. It may be none the less satisfactory from that point of view. The profit on sheep on thousands of farms is, as everybody knows, a profit in kind.

The profit in cash, originally declared to be from £6 to £7 an acre, has dropped in sugar beet advocacy to £3. It may not prove to be that. But suppose it were only £1 in cash and the rest in "advantages," would it be a thing entirely to be despised?

There is reason to believe that there are many thousands of Continental farmers, not Gibeonite smallholders living on next to nothing and working themselves into premature old age, but substantial agriculturists, who are quite willing to keep beet in their rotations on a smaller cash return than that, and in some cases, perhaps, for none at all.* Dr. Rabbethge, in the note just quoted, continues:

> It is hard to give you any average return which the German farmers obtain in cash for their beet crops per acre. Wet slices, dried slices, molasses, lime cake, beet tops and leaves are having such a high value, that *they often give the only return for the farmer, the cash obtained covering just the expenses of growing the beet.*

Beet v. Corn Crops.—Why should farmers go on accepting such a moderate return? Because, seemingly, so much of what is done for the crop can be credited to other crops and to the general improvement of the farm.† If not, why should German farmers not decrease their beet areas? Protection offers them a price for their corn far in excess of what our agriculturists can obtain. With the help of the artificials, the value of which they know so well, and buy so reasonably through their co-operative societies—the enormous advance in the consumption of artificials in Germany is a commonplace of modern agricultural writing—why should they not grow more corn?

The answer seems to be:

(1) That every German farming operation for a generation has been based on the beet rotation, where beet can be grown; and

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* The concluding sentence of "La Betterave à Sucre" is to this effect: "If it is borne in mind that expenditure on a great number of farms oscillates between £12 and £12 16s. per acre, and that a crop of 12 tons per acre at £1 a ton is only £12, it may be readily seen that beet culture in recent years has been often a losing business."

† "I have a field of barley which was last year half beans and half sugar beet. Any one can come and see that there is a marked difference between the two halves, that in which the sugar beet was grown being much better than the other. The whole of the tops were ploughed in."—A Norfolk farmer, in the *East Anglian Times*, June 13, 1911.

(2) That beet *is a cleaning crop, the cost of which is met in cash, and, with experienced management and economical working, and factories handy,* does leave a modest profit.

As a matter of fact, however, in Bohemia (Austria), which vaunts itself on producing a higher crop of beet per acre than any other country, only 60 per cent. of the original beet area is now put down to beets. The beet acreage in 1900-1 was 375,750 acres; in 1909-10, 270,955 acres. (Bohemia grows more grain per acre than any other Continental country.) Tables in the Appendix show the movement in the German, French and Dutch beet acreages

The Case for Mangel.—Another question: Why do not the farmers of Holland do away with beet and produce more mangel? In Holland there is no Protection on corn whatever. The country has turned, and will turn still more, to dairy produce. If the Dutch farmer cannot replace his beet profitably with corn, why should he not discard beet for that infinitely bulkier crop, mangel, which critics of beet growing assert to be so profitable?

Because the factories are in existence? Since when was the farmer in his commercial dealings an altruist? As a matter of fact, only one factory in Holland is co-operative, and only a proportion of the others in that country is run to any considerable extent by the capital of farmers. Can it be that beet offers advantages over mangels—in greater quantity of tops and leaves, in saturation lime, in improving the condition of the land with its deep roots and garden culture—which outweigh the greater cost of production?

The only reply that is to be made to this argument is (1) That the fact of the factories being in existence may be reasonably regarded as having something to do with the retention of beet in the rotation, and (2) that the mangel acreage is increasing, if slowly:

ACRES UNDER MANGEL IN HOLLAND.

1861-1870	14,282	1901-1905	41,117
1891-1900	31,162	1908	46,607
1909	47,887		

In 1910-11 there were 122,563 acres of beet grown against 139,613 in 1909-10, and 119,721 in 1908-9. But the whole area under the plough in Holland is increasing.

The subject of mangels *versus* beet is discussed in greater detail in the Appendix.

Co-operative Factories.—I suggested in 1910 that the establishment of co-operative beet sugar factories, in which the farmer should add to his return as a beet-grower his dividends as a sugar manufacturer, would be the surest way of setting about a sugar beet industry. Mr. Rider Haggard, after experimenting in Norfolk as a beet-grower and making investigations in Denmark as an economist, is strongly of the same opinion. As Holland, whence the proposals for sugar factories come, has as strong traditions of co-operation as Denmark, the Hollander missionaries will no doubt be perfectly ready to accept agricultural capital; indeed, they have all invited it.

The situation at present is that the farmers inclined to grow beet are waiting for the factories, and the people who want to build factories are waiting for the farmers to sign on for beet acreages.

Such a state of things appears to put an undesirable strain on human nature. The farmers experience an inclination, which they endeavour to resist, no doubt, to open their mouths very wide when the question of price per ton is mooted. The factory men are tempted, but, we must believe, try as far as possible not to take the most favourable view they can of the probable yield per acre, the preliminary difficulties and cost of cultivation, and the probable return in bonuses and dividends. They are all honourable men, but business is business; and it would promise a great deal better for the future of a sugar beet industry in this country if farmers and factory men were in council together instead of seeking to make the best bargain they can with one another.

Skill and experience are wanted as much in growing the beets as in turning them into sugar. These may be commanded to the full by combining the interests of farmer and factory, by yoking together English land, labour, and business ability with the best brains in the Continental sugar beet industry. Some sort of Anglo-Dutch combination, as I have suggested from the beginning, seems to offer many advantages: English and Dutch agricultural conditions are very similar, the climates of the two countries resemble one another, and—this is of some importance—the commercial methods of England and Holland are after the same pattern. Holland is also the beet growing country nearest East Anglia—where it is possible the first factory may be opened. As the sugar business has its fiscal side, it is also well to remember that the Dutchmen are prepared to accept the conditions existing in a Free Trade country, and are ready to get to work without any arrangement of duties.

Stringent though the contracts for beets may be made, it is well to recognise from the very start that if the district in which a factory is established is not getting a dividend out of the sugar as well as payment for its beets, its interests in the sugar beet industry will be circumscribed; it will endeavour by all lawful means to screw up the price per ton; and if matters should take an untoward turn—there are such things as wet, sunless seasons and sugar beet diseases—will assuredly stop beet growing.* The only sure basis for a sugar beet factory is large breadths of beets grown by its own shareholders on the principle of so many shares so many acres of beets to be provided.

Mr. A. O. T. Bennett, who has spent seventeen years on a beet growing farm in Germany, says:

> I am inclined to think that the most rosy side has been put before the public. I believe that we can grow sugar beet and make it a success, but, if we are to do so, we must profit by the experience of other beet-growing countries, and begin where they are at present. It has been a mistake from the first to assert that "the cultivation of the sugar beet is to all intents and purposes the same as for mangels." When more is known on the subject than at present, it will be found that the labour bill is much higher, let alone other factors. It requires both skill and forethought to make the sugar industry a success. Nothing should be attempted, either in farm or factory, without expert advice (the very implements on a sugar beet farm vary considerably from those in use in England), and though the initial cost will be heavy, it will pay in the long run. The foreigner in the past has learnt from us and is not ashamed to say so. It is now our turn to learn from him and profit by his fifty years' experience.

And he concludes, as Mr. Rider Haggard and I do, that in a co-operative factory is the best chance of success. I believe that James Duncan, who started the first sugar beet factory in this country in 1870, also felt that in well-thought-out co-operative effort was the best chance of a sugar beet industry in this country. *Half the sugar beets grown on the Continent are grown by the factories*, and the French Report of a deputation to German, Austrian, and Belgian beet farms states that "*the majority of the German factories are co-operative.*"

Alas! however, it is not possible to be particularly hopeful of practical co-operative effort. Although English farmers dispose of some 20,000 bacon pigs a week, it is only now that they are setting about the opening of the first co-operative factories. For reasons, many of which are perfectly sound, there is not here, as on the Continent, a custom of agricultural co-operation on a large scale.* (On the other hand, there may be more money in the hands of our people living outside the towns.) The first sugar beet factory which we shall see set going will probably be started by means of capital largely supplied outside the area which will contribute the beets. This is not an ideal arrangement. But as the money is likely to be furnished by people with some acquaintance with agriculture, and in sympathy with agricultural progress, its directors are unlikely to forget that it is to the interest of the enterprise that the farmers who grow its beet shall be fully satisfied with the return from their crops. Certainly our farmers, after permitting others to build the factories, cannot expect to be allowed to step in and annex the profits.

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* "The factory must have the beets; the farmer need not grow them."—Mr. Sam Mendel, Secretary, Kent Sugar Syndicate, Ltd.

The Prospect for the Farmer.—As most of the sugar beet grown in this country must be grown by tenant farmers, the success of a beet sugar industry is largely dependent on the attitude taken up by landowners and estate agents.† The beet grower must have security of

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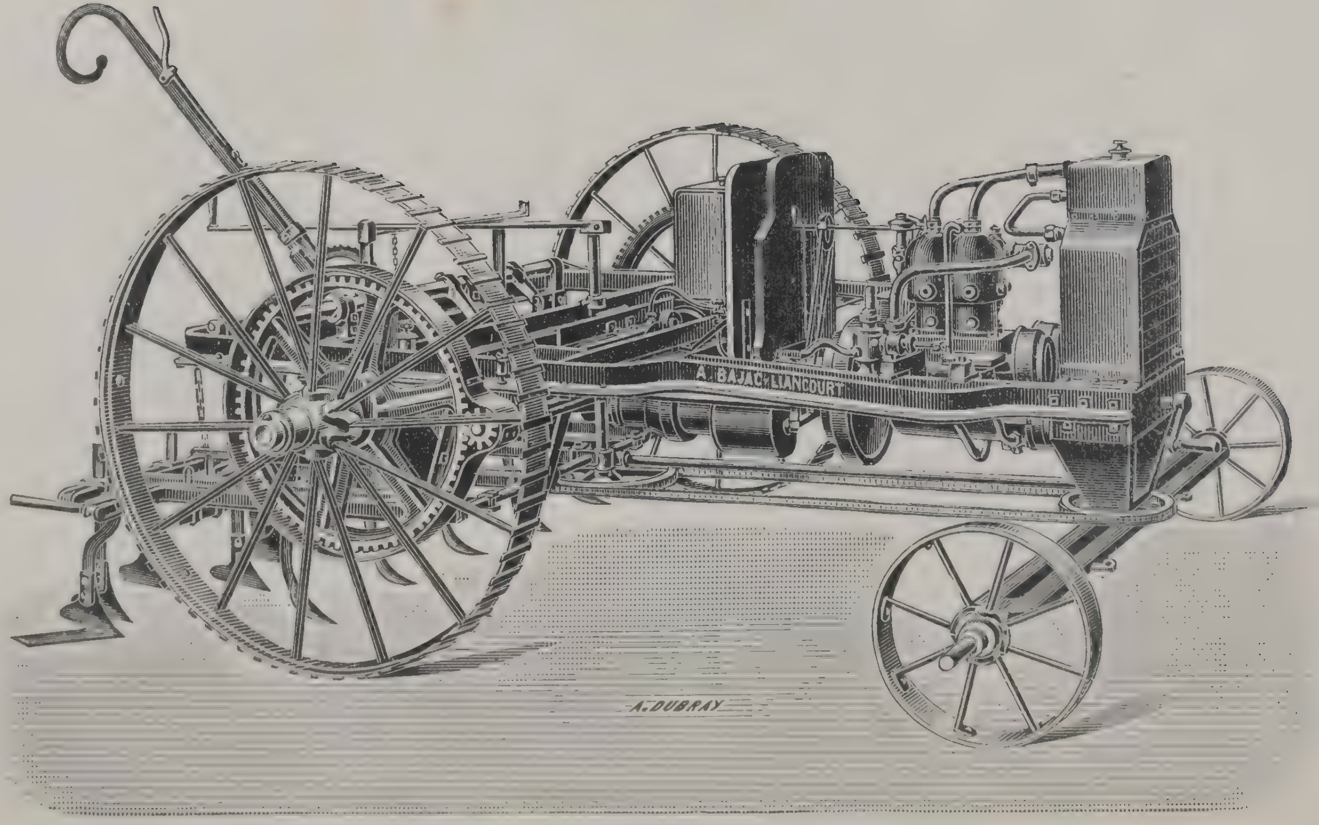
* There are in Belgium, I see in Mr. Rowntree's book, as many as 77 co-operative societies of beet growers.

† Freeholds and Beet Growing.—As the number of freeholders in Germany has been given as a reason for German success in beet growing and co-operative factory building, it may be of interest to note that there were in Germany in 1895:

2,260,990	freeholders	occupying	93,175,000	acres.
912,959	leaseholders	,,	13,400,000	,,
1,800	"mixed"	,,	2,500,000	,,

58 per cent. of the freeholders were on areas of not more than



FRENCH MOTOR-HOE FOR BEETS.

Six rows are dealt with at a time. This is practically the same hoe as on page 273, only provided with 10 to 12 h.p.

tenure if he is to reap the full value of his beet growing. Although many landlords have been helpful to the sugar beet propaganda, there has been opposition from others. It is the business of the factory advocates to show, more plainly, perhaps, than has been done hitherto, that beet growing will not decrease bullock feeding,* and is unlikely to eliminate mangels as a farm crop, also that the use of the residuals of the crop and factory, the deeper and more intense culture, and the introduction of a new rural industry are factors of importance to the countryside. (An estate agent once said to me that he would rather have a tenant who tilled well and ploughed deep than one who merely dunged well.) The statement of the French Report that leases are generally for 18 years in the German beet districts is not without interest.

To sum up:

(1) *On the facts as to the financial prospects of the crop which are available, and having regard to the experience which has been obtained and the limited amount of risk run by the farmers, there is good reason to urge that those who have suitable land in the vicinity of a proposed factory should make the experiment of beet growing for three or five years; and that they should be supported by their*

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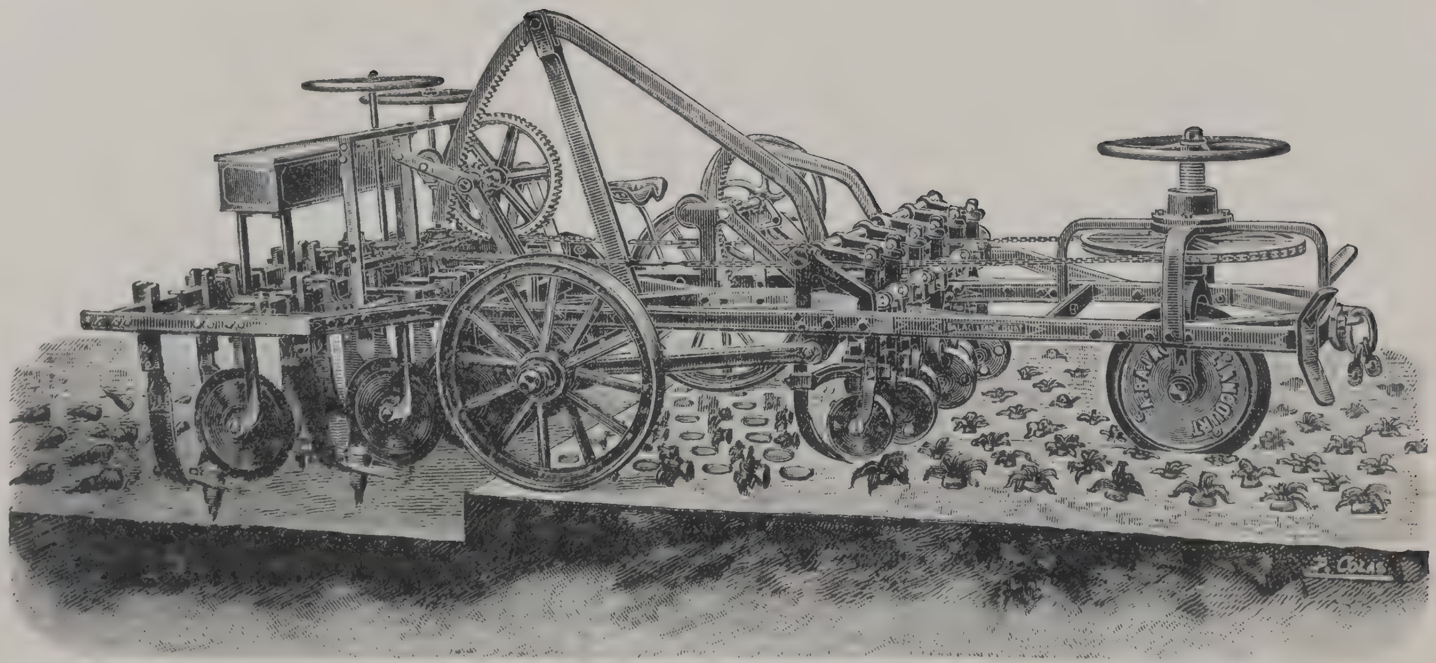
5 acres, 18 per cent. on areas of from 5 to 12½ acres, and another 18 per cent. on areas of from 50 to 125 acres.

In England, in 1908, there were 48,391 holdings which were owned, and 321,192 which were rented. In Great Britain 3,927,303 acres under crops and grass were owned and 28,284,083 were rented.

* This is largely dependent on what the value of the slices, *in English conditions*, is considered to be. For analyses, *see* Appendix. "Undoubtedly," writes a German correspondent, "farmers who deliver beet to the factory and do not bring back plenty of slices or plenty of town dung will ruin their land."



FRENCH BEET LIFTING AND TOPPING MACHINE.

Six rows are dealt with at once. The machine is hauled by the cable of a steam engine.

landlords and by local opinion. (2) *If the best price—not less than 20s. f.o.r.*[*] *for roots with a reasonable sugar percentage*[†] *—is given, a price it should be apparently within the power of properly planned and properly managed factories to pay, and the new crop is grown with the intelligence, business acumen, and attention to detail which distinguish our best agriculturists—proper regard being had to Continental experience—beet growing should prove as remunerative as it is found to be in Holland* by farmers who are not factory shareholders. *But the advantage which Continental farmers possess in having factories close at hand, and, in some cases, a choice of factories, should not be overlooked. Nor should the climatic advantages which some Central European districts enjoy be forgotten.*[‡]

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[*] The Company, which proposes to build its factory near Maidstone, is offering 21s. per ton at the factory, and if the farmers have to clamp, *i.e.*, if roots cannot be taken before November 11, 22s.

[†] "Securing the highest yield per acre is not necessarily the most advantageous method of cultivation in every country. German farmers are more concerned in increasing the weight than the richness of their beet."—French Report.

[‡] "The rainfall is, if anything, less in Germany and Bohemia than in France or, especially, in Belgium, but the cold is more intense in winter and the heat is greater in summer. . . . The intensely cold weather crumbles up the ploughed earth and greatly facilitates the working of the soil in the spring. German beet farms do not require to undertake such complicated tillage as French farms. . . . It is not sufficient to employ good methods as regards cultivation to obtain the best returns."—*Ibid.*

CHAPTER XXIV

FACTORY PROSPECTS

If living near a factory road
Do not expect a quiet abode,
For waggons rumble, whips they crack
As "beet" goes there and "pulp" comes back.

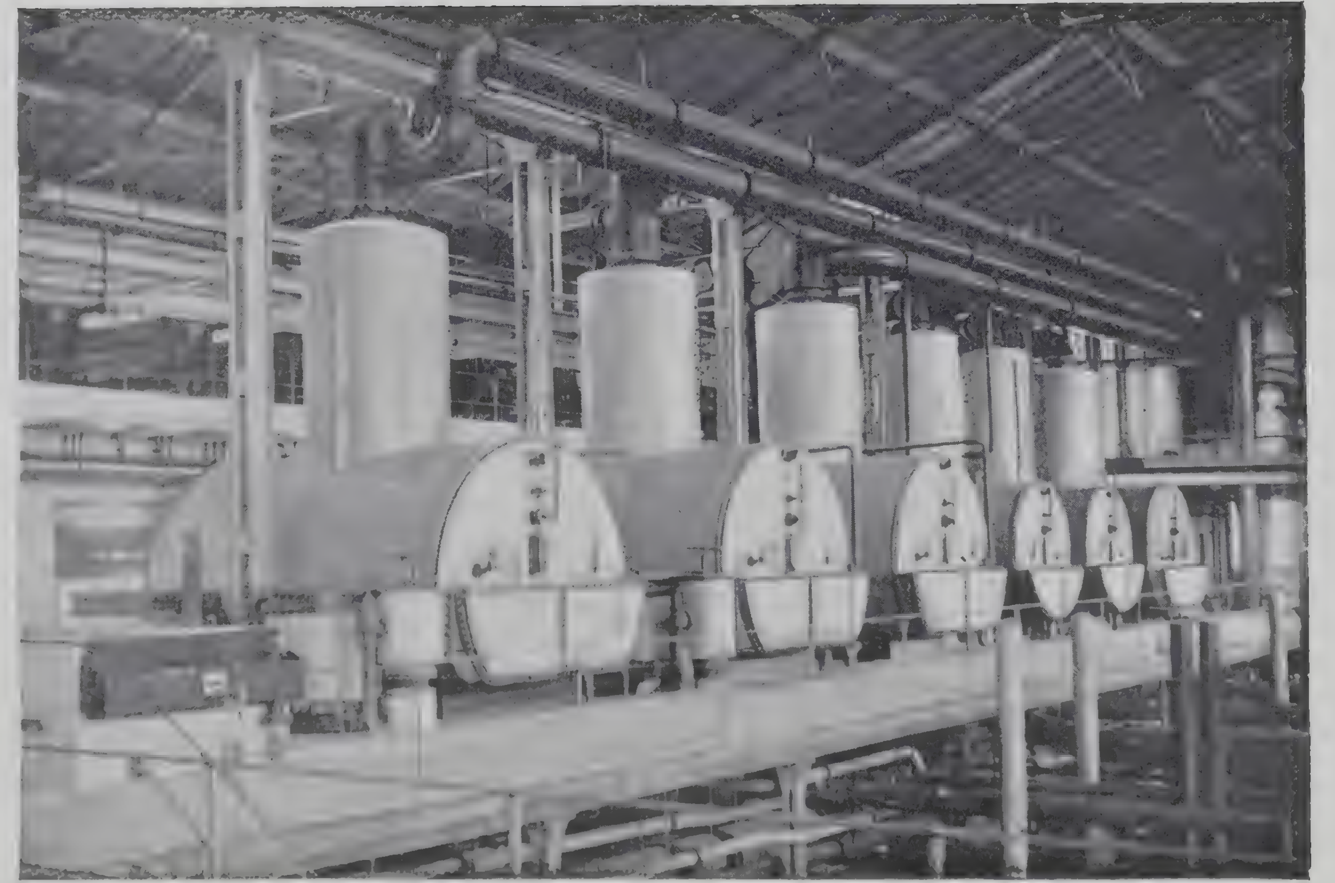
When making sugar out of beet
The smells produced are far from sweet;
And, more than this, the whole year through
You sniff them, if the wind be true.

Intending factory-builders pause,
Have some respect for England's laws;
Or else, too late, you're sure to find
Riparian owners far from kind.

For fish will float instead of swim,
And smells pollute our homes within.
The lawyers laugh; their pens they poise
To deal with fish and smells and noise.

—*Skit by an Anglo-German correspondent on the rhyme at the head of Chapter II.*

The Sugar the Continent Sends.—If all the area in Germany, France, and Holland available for beet has been devoted to it, as appears to be the case, the argument for the financial success of beet growing and sugar making in England is undoubtedly strengthened. The consumption of sugar, like the consumption of eggs, is growing on the Continent, and it is possible to argue that our supplies of sugar may fall off as our supplies of eggs are beginning to fall off from several countries. The following table (compiled from Mr. Martineau's figures) shows roughly the proportion of their beetroot sugar that the beet-growing countries named sent to us in 1909:



Evaporators at the Leopoldsdorf Factory

Countries.	Tons Produced.	Tons Exported to us.	
		Refined.	Raw.
Germany	2,079,220	416,432	373,315
Austria-Hungary	1,386,900	232,617	100,781
Holland	214,300	118,441	25,723
France	791,600	86,665	2,135
Belgium	257,300	41,129	19,333
Russia	1,240,300	29,980	973
Other Countries	529,940	20,240	——
	6,499,560	1,467,764	
Exports from Great Britain of sugar which has been refined here	——	32,256	
Total beet sugar from the Continent consumed ...	——	1,435,508	
Total raw cane sugar from the tropics consumed	——	292,393	

Herr Zelter, a Prussian agriculturist who was in England in 1910, said:

> I believe that the introduction of sugar beet growing in England would be advantageous to German agriculture. I consider that it is impossible to extend the cultivation of sugar beet in Germany. The demand for sugar is increasing with the growth of the population and the advance of the general well-being of the people. The export figures must and can decline without affecting the German sugar industry detrimentally.

But when stress is laid on the possibility of our supplies of beet sugar falling off, it is to be remembered that there are the potentialities of the cane industry to be taken account of.

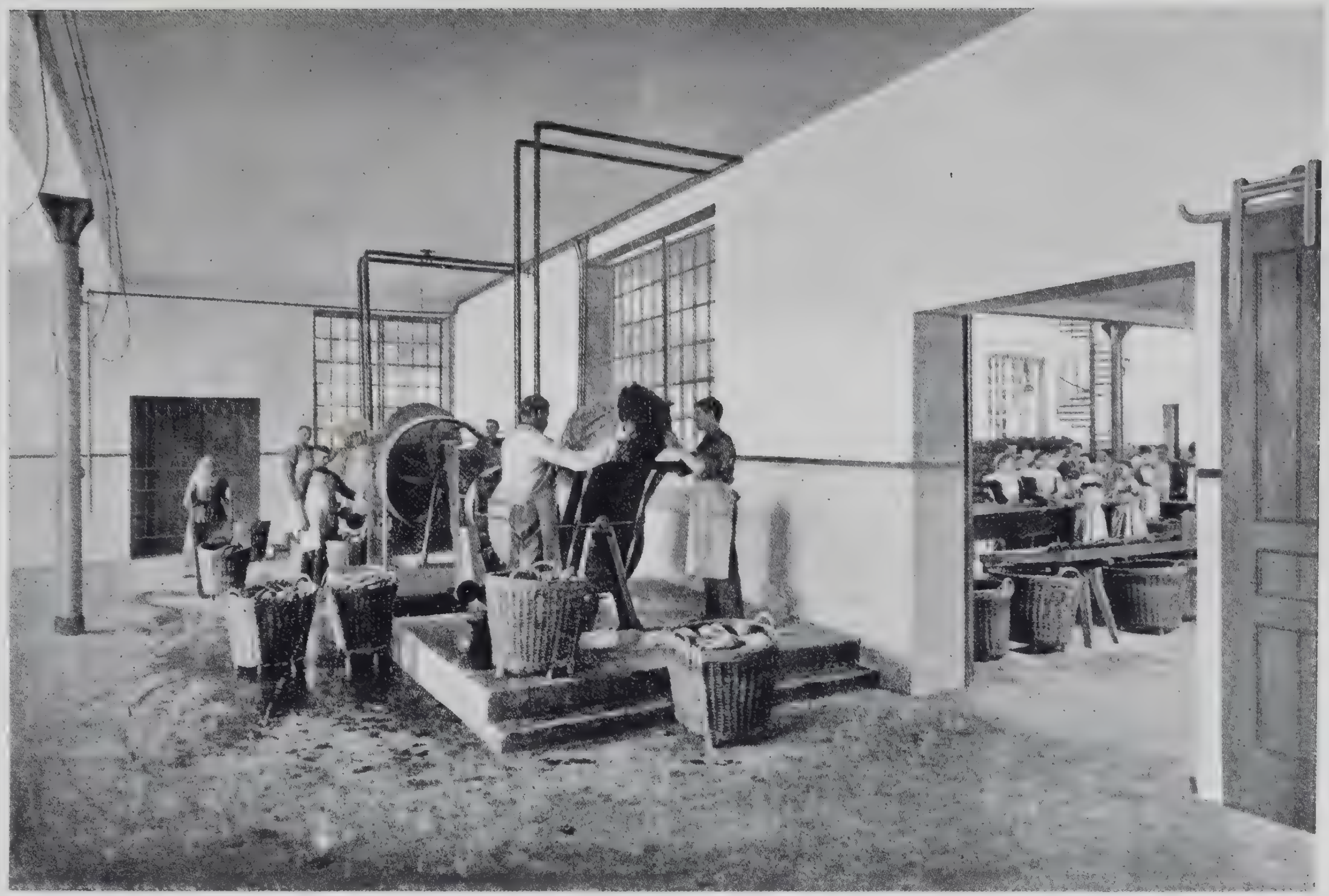
Anglo-Continental Factories.—Again, if there is such an excellent opening for beet sugar manufacture in England, why do not Continental capitalists come over and start factories here, as they have started in this country already since the passing of the Patents Act, factories to manufacture all sorts of things? These sugar experts know now the quality of our beets, grown experimentally and commercially, and they have a shrewd notion as to our production per acre. They have all the details of the equipment of beet sugar factories at their finger ends, they have all the experience of manufacture, of sugar schools—one at Brunswick has, I see, eight professors — and of the technical sugar press and literature. No Englishman in his senses would raise any objection to their coming. It would be realised that the experience gained for us by their factory would be invaluable in starting English factories in its wake.

An answer which might be given is, I suppose, first that without the co-operation of influential men in this country it would be difficult to secure the required area of beet; and, second, that Continental capital is chary of coming abroad for an enterprise in which so many of the facts as to costs and probable crops are indefinite.

If the second reason be well founded, it is also a reason, surely, for scrutinising attentively all the prospectuses of beet sugar companies, and for looking closely after the experts employed in connection with any factory which we may start with our own capital.

A third reason has been given more than once. This is that a factory is a greater advantage to the countryside in which it stands than to the manufacturers; but whether this statement be well-founded or not it is obviously no easy matter to get it believed!

No one seems to have drawn attention to the report by the Consul-General for the Netherlands in London to his Government, which was summarised on October 8, 1910, in the *Nieuwe Rotterdamsche Courant*, the leading commercial paper in Holland. The Consul-General speaks of the "great optimism" displayed at the British Association as to the prospects of beet growing and beet factories in England, and suggests that Dutch investors in English factories should take account of all the difficulties.



MACHINES (WITH AUTOMATIC EJECTORS) AT KLEIN-WANZLEBEN FOR WASHING BEETS WHICH ARE TO BE ANALYSED

Nevertheless, he speaks of "the manufacturers in Holland not underestimating the dangers of English competition, and approves of them "devoting themselves to an earnest study of it in their own interests," which hardly looks as if Consul-General Maas were of opinion that the difficulties were insurmountable.

Attitude of Sugar Refiners.—If the manufacture of sugar from beets grown in England is such an excellent business proposition, how is it that big firms of sugar refiners in London do not take steps to arrange for the erection of a beet sugar factory plant, and for the supply of the requisite number of acres of beets in their hinterland of Essex, or in Suffolk, where the Hollandia company has found some excellent beet land?

Everybody who looks into the beet sugar problem asks the same question. It is always received in Mincing Lane with smiles. The inquirer is asked in return two questions:

First, why should sugar refiners, who are closely engaged in their own business, step outside it and deal with matters of which they have no experience? They would have to build factories and learn the production of raw sugar from beets like other people.

Second, as to refiners at least putting capital into the beet sugar factories which other people are planning, why should the refiners help on rival manufacturers of granulated sugar?

The reader may decide for himself whether these replies are convincing. It is difficult to see why, if it is such a promising thing, refiners should fight shy of sugar from home-grown beet. We import nearly a million tons of foreign-refined, and if refined from home-grown beets were substituted for some of this it could make no difference to the British refiner, though "no doubt," as a refiner tells me, "there would be a cry that the British refiner was in danger."

Why should not the British refiner start a factory for producing raw sugar? It is interesting to notice that Mincing Lane is now represented by the head of a well-known firm of sugar-brokers on the board of Lord Denbigh's new Association. If he subscribes largely when the first factory prospectus is issued, it will be one of the strongest arguments for a factory yet forthcoming.

The Question of Capital.—With regard to the proposed capital of the various companies, it may perhaps be noted that Mr. Stein, in the course of his sugar beet apostolate, has urged that

> all the statements in the Press and elsewhere that a factory must have a capital of £130,000 to £150,000 are wrong. It is dangerous to over capitalise a factory for a new industry, as the consequences will be felt as long as the factory exists. The site of a factory could be rented on a long lease. The roads must be already there, and a railway siding at hand.

On the other hand, two undoubted authorities to whom I showed Mr. Stein's own figures called them too low. While it is true that beet sugar manufacture will not stand over-capitalisation—there is certainly no room for "development companies"—very little inquiry serves to show that the equipment and proper capitalisation of a factory cannot be done on a narrow margin. Everyone who makes a visit to a modern sugar factory must be struck by the complicated and up-to-date character of the sugar making and sugar refining processes. There is no end of expensive machinery. Obviously a cheese-paring policy in starting a factory which is to be in rivalry with the best factories of the Continent would be folly. Every year these factories are more efficient. The number of factories in the four countries nearest us has decreased for

Examining Beets at Klein-Wanzleben with Respect to Shape

more than one reason; but one thing is patent to any visitor to Holland: that those that survive are extended, and those that are built are bigger and bigger.

Indeed, there is talk of an ingenious scheme for disposing of factories in Holland as a preliminary to inviting the British public to co-operate in erecting one over here.

As to the most desirable size for a factory, Mr. Bennett, writing from his experience in Germany, is clear that

> it should be capable of working 50,000 tons of beet in the season,* working about fifty days, at the rate of 1000 tons a day. The acreage required to produce the above results would be from 4500 to 4700. It is claimed for England that the yield per acre and also the percentage of sugar is higher than in other countries; but it has yet to be worked out on a large scale, and it is here, I fear, that disappointment will begin. It will be well, therefore, for factories that are about starting to secure as large an acreage as possible, even above their expected requirements, so that they may be a success from the beginning. Failure the first year would be disastrous for the future prospects of the industry in this country.

The thousand tons specified was to be the quantity handled by the proposed Maldon factory—plus 150 tons of raw sugar in the refinery—but 500 tons is the figure which has been mentioned in connection with the Sleaford and East Sussex schemes. Mr. Stein proposes to handle only 300 tons at Kidderminster.†

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* "100,000 tons [in the campaign] would be still more desirable." —LORD DENBIGH, May 13, 1911.

"Taking 15 tons as the average crop of beet to be got from one acre, over 5000 acres have to be cultivated to obtain 80,000 tons, whilst over 10,000 acres are kept in reserve to be planted the following year."—MR. COHEN.

"The initial outlay, on the plant alone, for a factory to turn out 50,000 tons of sugar, would probably not be less than £60,000." —National Sugar Beet Association prospectus.

† Mr. Stein's latest figures, as quoted approvingly by "a member of Sugar Beet Founders Limited" in the *Hereford Times*,

German Dividends.—I may here quote a German correspondent's reference to a point which has an important bearing on the amount of expenditure necessary in the establishment of factories and is sometimes overlooked when much is made of the high rate of dividend paid by German factories:

> The official capital of the German factories does not give a correct impression. The factories were founded many years ago, and have been extended out of profits without enlarging capital. Generally the official capital is not more than about £35,000, while the real working capital is more than £100,000. A new factory of 1000 tons capacity calls for £150,000, including the necessary working capital.

April 29, 1911, are not the same as those set out on pages 58 and 59:

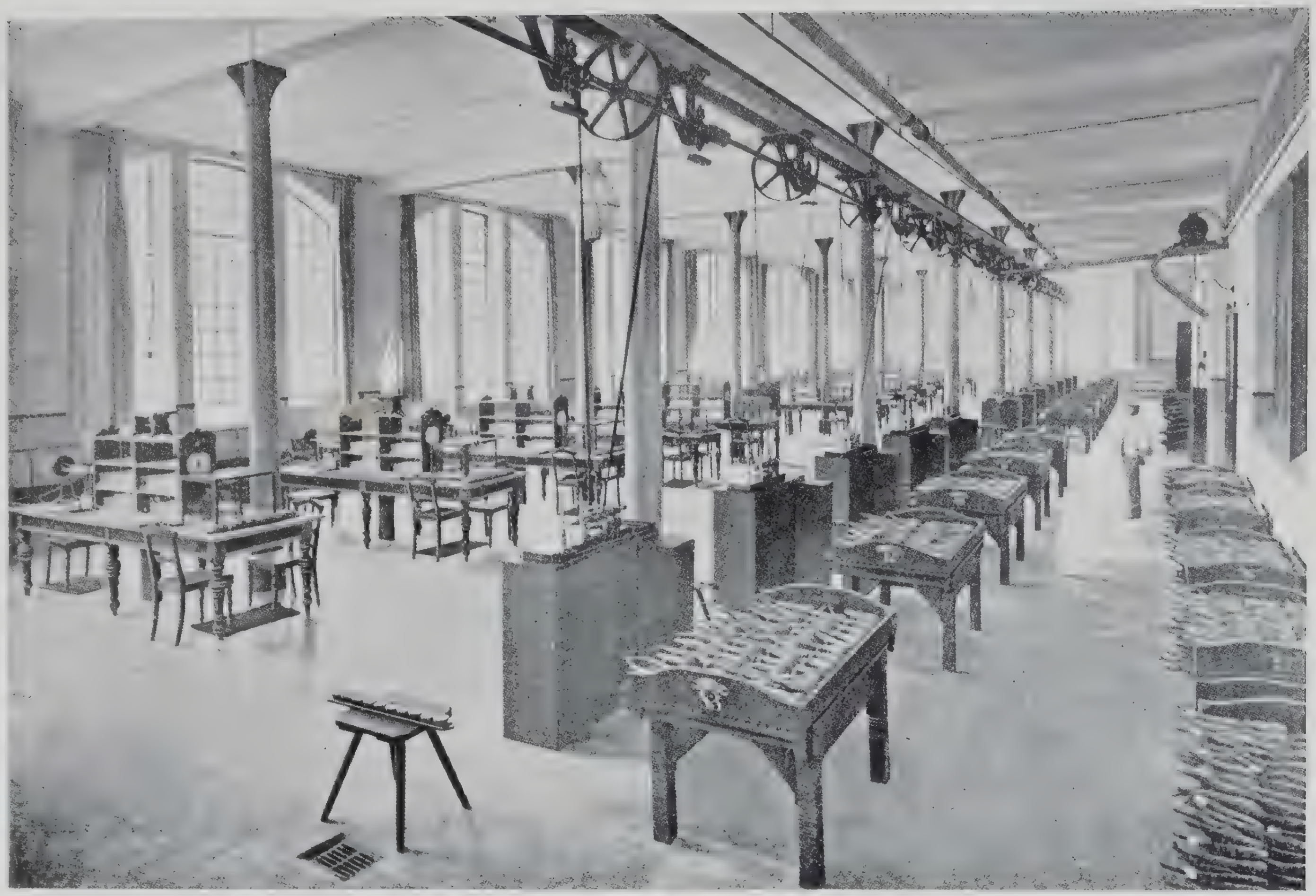
The capital for a factory equipped with the best up-to-date machinery would be about £80,000, distributed as follows:

	£
Machinery costing	30,000
Building factory	8,000
Working capital for paying for roots and working expenses	42,000
	80,000

Balance sheet of Beet Sugar Works.

Dr.	£	Cr.	£
Cost of roots, including expenses, 25,000 tons at 25s. per ton ...	31,250	3000 tons refined sugar produced at £13 ...	39,000
5 per cent. depreciation	1,500	2 per cent. 500 tons yellow sugar at 11s. 6d.	5,750
Profit	17,500	2 per cent. molasses, 500 tons, at £3 10s. ...	1,750
		30 per cent. slices, 7500 tons at 10s.	3,750
	£50,250		£50,250

The same colleague of Mr. Stein's assures the farmer that he will have a profit of "*£8 10s.* per acre if he grows beet."



The Head Laboratory at Klein-Wanzleben for the Selection of Mother Beets

No one else than Mr. Stein seems to have recommended a capital under £100,000. But because the expenditure necessary to the setting going of a really modern factory must be undertaken, or the matter must be left alone, this is not to say that a vigorous scrutiny of outlay is not imperative. In the most favourable circumstances for launching factories in England, only those which are under the guidance of persons of reputation and sound technical and commercial experience can have a chance.

Cautions to Directors.—The following remarks in a recent pamphlet by Mr. Martineau, who was handling beet sugar in the sixties, may well be quoted:

> It is impossible to emphasise too strongly the importance, from the point of view of those who propose to invest their capital in a beetroot sugar factory, of beginning by mastering the subject. Do the people of this country suppose that sugar factories abroad are started by amateurs? Far from it. Every man on the direction is an expert. The manager is as near perfection as human nature will permit. They do not pick up the first man who offers himself. Their factory is constructed according to the latest principles which have stood the test of time and trial. They never rush into a new thing, especially in constructing a new factory, unless they know from the experience of their neighbours that it is safe to do so. They take care that their farmers are fully instructed in all the latest principles of cultivation and manuring. If a sugar factory is to be a success in this country it must be started on these lines. If not, failure is a certainty. Any manufacturing operation in connection with sugar must be regarded as a very serious matter requiring great expert knowledge.

The same writer has added in the *International Sugar Journal*: "No one should attempt to become a director of a beet-sugar company without studying completely all that is to be learned from a careful and prolonged visit to the best factories and districts on the Continent." Perhaps these further words of warning from M. Dureau, of the *Journal des Fabricants de Sucre,* may also be given :

> During the nearly forty years that the writer has occupied himself with sugar matters he has assisted, in France, at the *débuts* of numerous beetroot sugar factories. In general, these *débuts* have been most difficult, and this from various causes: short supply of roots, imperfections in the machinery, impossibility for the factory to produce in its first campaign its maximum quantity and to reduce its cost of production to the estimated figure, often, at the top of all, fall in the price of sugar, following a period of scarcity during which the creation of the factory had been decided on. From all this a greater or less loss of money results; hence reduction of capital, new call for funds, &c. Let our friends the English, therefore, act with prudence; let them neglect none of the measures necessary for insuring, if possible, the normal running of their factories from the moment of starting work. Such is the advice that we presume to give them with full impartiality and with the sincere desire to see success crown their efforts.

"Even on the Continent, where the men are highly trained and where nearly everybody understands the industry," said Lord Denbigh in the House of Lords, "the factories did very badly in the first year or two."

As to the dividends of the German factories, they are attractive, no doubt; so are those of the amalgamated Danish sugar factories during the past three years—17, 25, and 23 per cent.; but such returns have only been obtained as the result of long experiment and great experience, and, in the case of Denmark (which is outside the Convention), behind a tariff wall.

"I don't think that any great fortune is to be made out of the factories," Lord Denbigh owns. "If we can obtain an average of 5 per cent. to 10 per cent. we should be content."

It is probable that whichever factory has the luck to open first will have to buy a great deal of experience rather dearly. Its experience will be invaluable to its successors, and, as no factory really competes with another outside its own growing area, that experience will be available. Factories which do not start in co-operation with a Continental firm of repute must rely on their consulting experts and their departmental managers and foremen, who may or may not be well chosen. These factories, in the trying years of infancy and adolescence, have odds against them. If one factory were well on its legs, others, under purely English control as to the directorate, might walk in its footsteps.

Coal.—One who is entitled to speak with great authority assured me that for some time our costs per ton must be much heavier than in Germany. This is obviously a matter for discussion by experts. I have tried to obtain some Continental figures as to the cost of coal and labour additional to the labour prices given in Chapter XIV.* It has been suggested that coal would be cheaper in this country, and labour probably dearer. This is confirmed by my information. A German correspondent writes: "The cost of the coal varies very much, according to the situation of the factories in regard to the collieries. On the average the price at the factory per ton for good black coal of 7000 cal. and more is 20s., for brown coal of 2800 to 3000 cal. 6s. to 6s. 6d."

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* Mr. Courthope has estimated that his factory, handling half the quantity of beets to be handled by the Maldon factory and many Continental factories, would consume in a year 5000 tons of coal, 2500 of coke, and 2000 of limestone.

Mr. Koppeschaar has stated that a raw sugar factory consumes about 6 per cent. to 8 per cent. coal and about 5 per cent. limestone per beet weight.

Labour.—As to labour, a director of a Dutch sugar factory writes to me:

> The wages of farm labourers are on the average 2s. 6d. a day, but locally and temporarily they sometimes go considerably above and below this, according to demand and offer. The wages of sugar factory workmen vary from 3d. an hour for outside labourers to 5d. and 5½d. an hour for the principal factory men.

A correspondent informs me that a German factory which employs Italian labour, and handles 6500 tons of beet weekly, pays in wages from £300 to £350 weekly.

Mr. A. D. Hall is undoubtedly right when he says that "the scientific assistance, so freely lavished in a German factory, would have to be paid for at a much higher rate in England."

Fluctuations in Sugar Prices.—As 1910 opened, an authority who has always spoken with deliberation about the prospects of a beet sugar industry in this country expressed the opinion that the results would be satisfactory if sugar were selling "at any price above £10 a ton for 88 per cent. beet" (*i.e.*, raw sugar).* This was an encouraging speech, seeing that sugar was over £12 a ton. For some time, however, sugar was at £9 a ton (or 9s. a cwt.), and, at times, below £9. This fall in price is one of the lions in the path of the proposed sugar industry. The factories cannot go on making things financially agreeable for the farmers if they are not financially agreeable for themselves. At the time of writing sugar is at £10 10s. "They were afraid of a reduced Cuba crop," writes an expert to me, "and the beet people are sowing more than was expected, and markets are flat."*

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* Mistakes are frequently made by confounding raw and granulated prices. Roughly speaking, granulated, that is refined, sugar may be reckoned to be worth about 2s. more than raw sugar. If raw sugar is quoted at 10s., the price of granulated may be taken as 12s. The quotations of raw sugar and granulated sugar are both f.o.b. Hamburg. The raw sugar is 88 per cent. There are all sorts of raw sugar, but it is the price of the 88 per cent. basis which is used in quoting the prices of raw sugar; 88 per cent. beet sugar is sugar giving a theoretical yield of 88 per cent. It polarises, say, 94 per cent., from which is deducted five times the weight of the ash, say, $1{\cdot}2 \times 5$. So $1{\cdot}2 \times 5 = 6 - 94 = 88$. In the United States they have a higher standard for raw sugar quotations, viz.: 96 per cent. polarisation. The U.S. refiner actually gets about 4s. per cwt. more for his granulated than what he gives for his higher class raw sugar.

The way in which the price of sugar has tumbled about is notorious. It is unnecessary to do more than note changes of price within the last few years, within even a few months, in order to realise the difficulties encountered in gauging the prospects of an industry by the figure at which sugar sells. In August, 1910, a large subscriber to the proposed Lincolnshire factory wrote that, whereas in preparing its balance-sheet sugar had been estimated at £12 a ton, the price was now £17, which would have made the estimated profit not £20,500, but £43,000. "There are factors," he went on, "which lead one to the conclusion that prices will never be so low as in 1908." Alas, by November the prices were below the original figures of the Lincolnshire factory prospectus!

For the following prices of 88 per cent. beet sugar per cwt. f.o.b. Hamburg for every year since the abolition of the sugar bounties I am indebted to Dr. G. Schack-Sommer:

HIGHEST AND LOWEST PRICES (RAW SUGAR).†

Year.	Highest.	Lowest.	Visible Supplies. Oct. 1.
1904-05	16s. 3½d.	8s.	1,295,000
1905-06	10s. 4d.	7s. 9d.	1,259,000

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* Now comes a new scare—drought—and prices are up to nearly 12s. for 88 per cent. beet sugar.

† For other tables of sugar prices, *see* Appendix.

Year.	Highest.	Lowest.	Visible Supplies. Oct. 1.
1906-07	10s. 3d.	8s. 7d.	1,274,000
1907-08	11s. 11¼d.	9s. 5¼d.	1,131,000
1908-09	14s. 3d.	9s. 11¼d.	1,017,130
1909-10	14s. 9¾d.	10s.	1,131,270

AVERAGE PRICES.

1904	10s. 0¾d.	1907	9s. 5¾d.	1909	10s. 11¼d.
1905	11s. 2d.	1908	10s. 5¾d.	1910	12s. 9d.
1906	8s. 7¾d.				

Between December, 1909, and December, 1910, the price has ranged from 14s. 9d. to 8s. 11¾d.; between December, 1910, and July, 1911, from 9s. 0d. to 12s. 0d. The average price during the past seven years has been 10s. 5d. I understand that the calculations in regard to the proposed Kidderminster factory are based on an average price of 12s. granulated, that is 10s. raw.

German Profits.—It is possible to argue, of course, that if the German factories could pay from 20 to 30 per cent., and even 35 per cent. in 1909, when sugar was at 10s. raw, there should be a margin even at 9s.; but these profits were made in an exceptionally good year for high sugar percentages and by the best equipped and most experienced factories. The profits for 1910 were also large owing to sales being made at high prices. But we have always to remember, in regard to Continental factories, that a company which has been established for many years, which has reduced its capital out of profits, and is assumed to have benefited in the past by the paternal solicitude of the State antecedent to the Brussels Convention, is able to earn returns which would be quite beyond the reach of a new factory burdened with all its newly incurred expenditure for buildings and equipment and the exceptional expenses and uncalculated losses attending the establishment of an industry new to this country.

The 10s. per cwt. Limit.—Further, when Dr. Schack-Sommer, who has been for years a sugar refiner and an advocate of beet growing and of beet sugar factories, makes a considered statement as to 10s. a cwt. being the limit for a successful industry in this country, he may be assumed to mean exactly what he says, and weight should be attached to his opinion.

I have had the advantage of discussing the matter with another authority on the sugar industry, and he was by no means disposed to approve of the starting of sugar factories with sugar at its present price.

> I have a strong opinion (he writes, as he has strongly maintained for years) that it will be impossible to start the industry with any certainty of profit without Protection, the same as there is in every other country. All foreign countries have a protective surtax equal to about £2 10s. per ton,* and without this one could not hope to succeed, especially at first, while educating people both in the growth of roots and also in manufacturing operations.
>
> After very mature study, extending over many years (said Mr. B. E. R. Newlands in 1905, and I do not believe he has changed his opinion), I have arrived at the conclusion that beet sugar would not be profitably produced in England unless the growers were given the benefit of the surtax the growers on the Continent have, *and there is not the slightest chance of getting that benefit.* Again, if the home growers were allowed the surtax, the Colonies would also want it, which it would be impossible to give under the Convention. I would give a good many years of my life if I could see the industry at work in England, but the chances are absolutely nil. I discussed the matter with Mr. Duncan a week before he died, and we were both entirely agreed. It costs £9 per ton to produce an 88 per cent. beet sugar on the Continent, and exactly the same in this country. The

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* Holland has not.

> English manufacturer could produce it just as cheap, because he has cheaper fuel, and labour and rent were not dearer.
>
> To start the industry under present conditions (writes Mr. Eastick, of the Martineau Sugar Company) is to court disaster.

The question of Protection and the imposition of a duty is discussed in the next Chapter. All we need to do at the moment is to take note of the fact that more than one authority is doubtful of the success of factories without Protection, and that, in the opinion of a large number of people, the prospect of their getting it is remote.

Mincing Lane.—With regard to business men connected with sugar refineries in this country, or with departments of the wholesale trade in sugar, it is natural that their adverse opinion or lukewarm attitude should be discounted by the suspicion that, human nature being what it is, the views of Mincing Lane are likely to be insensibly affected by the prospect of the establishment of an industry which may be thought to be, rightly or wrongly, in opposition to its business interests. The amount of sugar that a single factory could produce would be, however, a bagatelle compared with the total requirements of the English market, and this must surely be recognised.

Says Lord Denbigh:

> I cannot understand why our great confectionery manufacturers, who are wholly dependent on foreign sugar for their raw material, should be so concerned about the present import duties on sugar, amounting to one-fifth of a penny per pound, and should apparently pay so little attention to the possibility of developing the home industry, which might provide large quantities of their raw material at their own door.

Here is a reply from a speech by Mr. George Mathieson, who belongs to a well-known firm of confectionery manufacturers:

> Beets could be grown very well here. There was no mystery about it, and it was difficult to see why such a fuss should be made of

so simple a matter. Every day men in numbers were risking capital in establishing businesses of various kinds in the hope of making money, and they asked and expected no Government assistance. If landowners and agriculturists thought that there was money in beet-sugar growing, let them co-operate, and soberly and quietly assume the risks themselves, and take the profits, and not attempt as they were doing to get on the backs of the taxpayers. Sugar consumers would be delighted to have another source of supply. The vexatious delays and costs in handling taxed goods were often heartbreaking.

Another advocate of beet sugar factories has cried aloud:

> Germany, with a home demand not much more than half ours, not only supplies all her own sugar, but has, every year, more than a million tons for exportation, half of which is refined sugar.

Does not a *Times* reviewer of Mr. Rider Haggard's book on Denmark throw some light on the mystery if we substitute "Germany" for "Denmark," the words "beet culture" for "agriculture," and assume our "subsidies" to be paid for sugar instead of butter and eggs?—

> Denmark has organised agriculture with a thoroughness unparalleled in modern history; and, driven by necessity, has achieved results that make her the model of the world. It is quite obvious that England could do what Denmark has done. We have as good a soil, as good a climate, and an incomparable market at our elbow. We are content to pay Denmark these subsidies—so many millions for eggs, so many for butter. We are not forced to pay them. We pay because it is our policy to pay rather than to involve the machinery of the country in the labour of increasing home production.

As a matter of fact, the value of our imported sugar (£21,000,000 in 1909) is less than that of our imported butter (£22,000,000). After all, is it unreasonable to suppose that Mincing Lane and "our great confectionery makers" may know something of the ins and outs of the sugar industry, and of their own and the nation's requirements, which is hidden from critics who have no practical acquaintance with the sugar trade?

The Outlook as to Prices.—In the opinion of Mr. Martineau "it does not appear that prices will recover, bar accidents, for many a long day." Says a review of the sugar trade written from the point of view, not of farmers, but of sugar sellers:

> It is probable that a conjunction of circumstances may arise which will lead to a much lower price than is generally anticipated, and the only relief appears to be in its maintenance for a period sufficiently long *to cause producers loss.* The remedy of a drastic reduction in acreage in Europe, with a check upon increased plantings in Cuba, would then be applied to the situation, and produce an instantaneous cure for over-production.*

In 1910-11 there was a remarkable beet crop, 8,127,000 tons, against the 6,138,000 tons of 1909-10.

When one who is intimately identified with the beet sugar industry read what I had so far written he said:

> As a low price of sugar means perhaps a low price paid to the farmers for their beets, it stands to reason that only farmers who can grow large crops will be able to grow beet at all, thus weeding out all the fields producing poor crops, and reducing automatically the acreage under cultivation. It is also important on the part of the factory to buy in such times only those beets which give the highest percentage of sugar, so as to get as much sugar as possible for the same cost, and it naturally follows that England will be in a far better position than any Continental country for these two important reasons: (1) On good soil the crops are very large. (2) Beets grown in England give slightly more sugar than on the Continent.

Sugar Making-cum-Refining.—It is suggested that a factory with a limited capital to deal merely with local beet is one thing, and a large factory under thoroughly competent Continental direction, set up where agricultural

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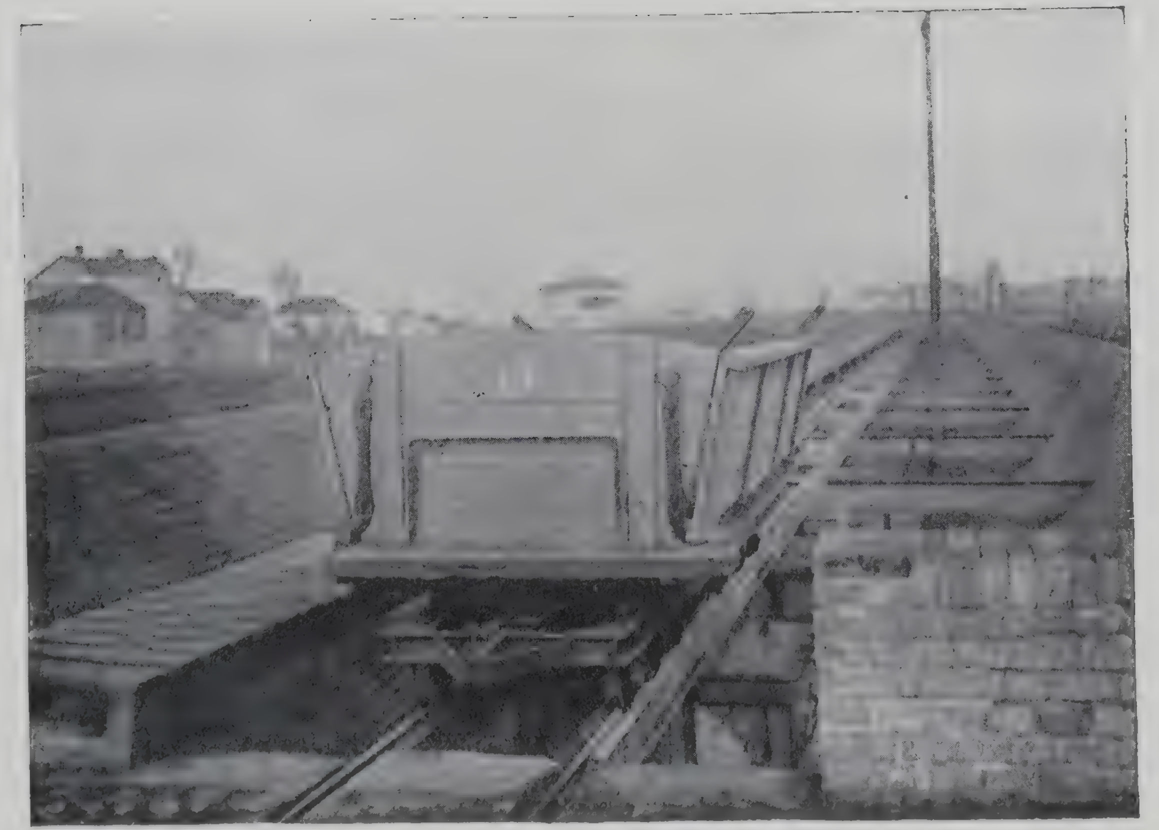
* Two "accidents" have since happened: a falling off in the Cuba crop and drought in parts of Germany and Austria.



Collapsible Railway Waggon, after Discharging Beets into the Storage Pit

This is at a factory which does not have the concrete slope arrangement support is assured, and able to refine imported raw sugar during the part of the year when it is not dealing with local beets, is in a different category. It would be an enterprise, it has been contended, which could get value out of its expensive machinery all the year round, and would be able to buy its raw sugar and sell the refined article in the most favourable states of a perpetually fluctuating market. Obviously, such an enterprise needs to have command of a substantial amount of working capital. It is certain that it is by their dealing as well as by their manufacturing that some up-to-date Continental factories are making money. This is one of the reasons why I found Continental manufacturers by no means disposed to abandon the idea of a successful sugar industry in England merely because sugar had touched 8s. 11¾d. They laid stress on the necessity of taking long views and on not being discouraged by the temporarily low price of sugar or by the disappointments necessarily attending the growing of the first commercial crops of beet in this country. High sugar finance is, however, no simple matter, and I have seen an undoubted expert shaking his head very gravely over plans for sugar manufacture-cum-refining. Here we are obviously on highly technical ground.

The proposal of a factory-cum-refinery has certainly a most attractive look to the novice.

> Remember (writes one such) how the straw hat makers at Luton took up felt hat making during the slack season. Why not work 12 months for a 12 months' dividend?

An acknowledged authority once wrote to me on the subject:

> The German factories pay good dividends in spite of being idle three-quarters of the year. That good refined sugar can be made in a beet factory, in spite of the fact that it is done without animal charcoal filters, has been proved long ago. But the real refiner will

always cut it out in quality. The fact of our Dutch friends proposing refining along with sugar manufacture shows that in their opinion it would pay. I have every respect for their opinion, because I believe them to be good business men.

A correspondent expresses the opinion that not more than 5 per cent. of the German factories are also refineries. (A table in the Appendix throws some light on the German factories' methods of working.)

Plainly, if a factory is going to buy raw sugar, it should be situated not only in a well-chosen beet district, but within the cheapest freight rates from Hamburg.

A Beet-cum-Cane Factory.—In the United States an effort has been made to solve the problem of the factory closed for five-sixths of the year. The plan is to import evaporated cane from Cuba. The Wisconsin beet sugar factory, which is trying the experiment, had its first twenty-five car loads in August, 1910. Further car loads were imported in February, 1911. The experiment with the "dried shredded cane" is stated to have been successful. Paper is one of the by-products which can be made from the cane refuse. So far, no particulars as to the cost of evaporating the moisture from the shredded cane and of baling and transporting the material have been published. (An alternative scheme has been suggested in Demerara, that the canes should be torn up in clumps as they grow and be shipped as they are, canes, roots, tops and all.) The difficulty with cane and beet alike hitherto has been that, once they were broken up, sugar manufacture must be proceeded with at once, or fermentation would set in. The shredded cane process is one of drying up the cane, not of pulping it.

Half-Factories.—It was lately suggested in print that the cost of transporting beets to the factory might be reduced by "extracting the juice on the farms." As already

Part of the Klein-Wanzleben Factory and Seed Establishment explained, Mr. Duncan transported syrup from the pioneer Lavenham factory to his London refinery in hogsheads, and on the Continent various experiments have been tried by piping juice underground after treatment with lime. At Cambrai there is, or was, a pipe system which transported the juice of 10,000 acres of beet. I believe the system has been tried and abandoned in various places on the Continent. There is one of the half-factories for producing juice in Belgium, but I hear that it is doubtful if the system is a success. The piping and cost of maintenance are too heavy, and there is the rent to be paid for passing the pipes through different properties. The Director of the Sugar Institute in Berlin is kind enough to reply to an inquiry as follows:

> The system of raperies, as they are called here, is in use in Belgium in the Wanze sugar factory, in France in the Douaville sugar factory, and, as far as I know, is only employed in one North American sugar factory. In Germany this system is not used, as it is very unpractical, and, in my opinion, is only of substantial utility when, owing to unfavourable physical conditions, railways and canals communicating with the central factory are impracticable. When for example, as in the Wanze factory, the juice is dealt with at thirteen different places, thirteen diffusion batteries are necessary, while in the central factory two are sufficient. A considerably larger staff is also requisite.

The Factory Farm.—It may or may not be desirable for a factory to be a factory-cum-refinery. There is a very great deal to be said, however, for it being a factory-cum-farm. As already stated, half the beets grown in Germany are grown by the factories which extract the sugar from them. Lord Denbigh, as the result of his Continental investigations, has lately expressed the opinion that "it would be very unwise in most districts to start any factory in this country unless, at the outset, it had the control—

either by ownership or lease—of a considerable acreage, say, 1000 acres." A factory farm would not only secure growers' profits, but form a valuable object lesson to the factory's farmers. Obviously, however, such a holding would throw increased responsibility on the directors of the company.

There is another matter besides the "overestimation of the capacity of the community to produce beets," to which an American writer refers. "It is important," he says, "to consider the adaptability of the region to other crops productive of larger money returns. The beet crop is now being rapidly supplanted in parts of Idaho and Colorado by fruits and vegetables." This is undoubtedly a possibility to be reckoned with.

Waste Waters and other Matters.—One advantage of a factory having a large farm adjoining is that it would be in a better position to deal with the problems of foul water, deposited soil, and the smells due to the protein therein. No English writer has ever spoken of the vast amount of soil washed from the roots. Think of the pile of soil from 50,000 tons of roots! On the Continent the farmers have each to take away their share, "but this business," a correspondent writes, "is, along with river pollution, a cause of serious ructions." It is he who sends the skit at the head of this chapter.

Mr. E. Koppeschaar, in the *International Sugar Journal*, explains how the waste waters—"they never contain disease germs," he notes—may be separately handled:

> Measures should be taken, by proper additions of lime and iron salt, to reduce the nuisance they cause, as well as the complaints aroused by them, to a minimum. If the waste water from the battery (including the water pressed out from the pulp) is properly limed, a heavy fermentation will set in, causing most impurities to be split up into gaseous substances (the sugar into water and carbonic

acid gas, the nitrogenous substances into ammonia gas and nitric acid), which process is accompanied by the formation of a thick layer of foam on the surface. The wash-water from the beets, containing the adhering dirt and sand, is best kept separate, also, and led into settling basins. The difference between these waste waters will be seen from the following data referring to samples the writer took:

	$KMnO_4$,* mgrms. per litre.	Solid substance, mgrms. per litre.	Suspended matter, mgrms. per litre.	Loss on ignition, mgrms. per litre.
Original fresh water from river.	44·2	—	—	—
Wash water...	726·8	5050	4515	4525†
Battery water	3091	2810	1425‡	660
Cleaned waste water returned to river.	189·6	—	—	—

Conclusion. — A German correspondent with great experience of many branches of the sugar beet industry has written to me:

> It is hard to give you any definite opinion on the prospects of a factory to be built in your country. I cannot see why it should not be possible, and why there should not be success if the start is made *after careful investigation of the whole subject and under good management.*§

It is this "careful investigation of the whole matter" which so many beet enthusiasts do not appear to have made. There is room for doubt, therefore, as to their succeeding in starting "under good management." To conclude, *provided there is "careful investigation of the*

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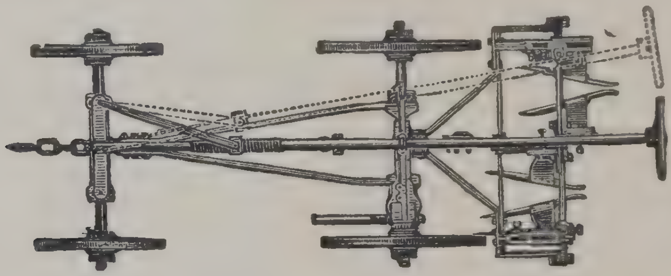
* Potassium permanganate: its percentage is a measure of the organic substance.

† The larger part of this is earth and sand.

‡ To a large extent cellulose.

§ "The whole crux of the matter," says a German correspondent.

whole matter," "good management," and proper support from farmers within the immediate vicinity of the factory,



Plan of a German Beet Harvester

such a factory appears to be, in Dr. Schack-Sommer's phrase, "a fair business risk."

As to the prospects of an industry, *in the developed condition of our agriculture and with the probability of increasing efficiency in the production of tropical cane sugar, it does not appear possible that sugar beet would have the opportunity of achieving in England what it has achieved on the Continent and may achieve in some parts of the United States.**

But there is evidence pointing to the possibility of such an industry proving a useful factor in bringing about in many parts of rural England changes of some value, agriculturally and sociologically. This being the case, the beet sugar question unquestionably deserves the careful and sympathetic study of all interested in the improvement of the agricultural and social conditions of the country districts.

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* The *Journal of the Board of Agriculture*, writing on another subject than sugar beet (February, 1911), said: "It must be remembered that the average American farmer is frequently unacquainted with the elementary facts connected with the rotation of crops and manuring, which seem to the British farmer inseparable from ordinary agricultural practice. There is, consequently, a wide field in the direction of spreading knowledge of the rudimentary principles of good farming."

A Corner of the Area on which the Hollandia Factory's Waste Water and Saturation Lime are Run

CHAPTER XXV

THE PROBLEM OF STATE HELP

"ARTIFICIAL stimulus did not promote permanent success. A sugar factory is a plain business proposition. It should rest entirely on its merits. This should be thoroughly understood."—American Department of Agriculture's "Progress of the Beet Sugar Industry in the United States."

The Difficulties in the Way.—As to State help for smoothing the path of the first factory or factories, all sorts of plans have been framed. If only they did not run counter to the Sugar Convention, to the clause in the Development Commission Act, forbidding grants to companies trading for profit, or to the political faith of those who are not the less desirous of seeing sugar factories tried here because they are not adherents of Preference and have a Government of their own way of thinking in power, something might, no doubt, be said for some of them.

Various Proposals.—A typical proposal, which is as impressive as any at first sight, is that the Development Commission should find the money for building and equipping a factory in the form of a State Beet Sugar Experimental Station, and should then lease it to a company, which should work it with a restriction as to *maximum* dividends. There seem to be at least three difficulties in the way of such a scheme, the liabilities of which may be studied in the case of a somewhat analagous State experiment now being made in Victoria. The proposal that the Government should advance debenture capital for so many years, or stand, in some way or other, behind capital as guarantors of a minimum dividend, or make a money grant, is barred by the statutory inability of the Development Commissioners already mentioned. Turning from the Commissioners to the Treasury, one who is interested in the sugar beet movement asks, "What is the difference between offering £700,000 for the Thorney Estate and finding debentures for sugar beet?" Whether the Treasury will be able to see its way to help in a matter which, if it is a case for assistance, may be regarded by the authorities as being within the scope of the benefactions of the Development Commission remains to be seen. An application in July, 1911, was refused.

A proposal to guarantee to farmers a minimum price for beets, or make grants to them, is admitted by Lord Denbigh to be contrary to the Convention. Of the general proposal of grants from the Development Fund Lord Denbigh has said that it is "a very impracticable one."

One suggestion has been that the Maldon scheme, which depends for its success on the deepening of the Blackwater, might be assisted by a grant in aid to the Maldon harbour commissioners. But cannot one hear Whitehall asking how many other harbour commissioners would not be able, if such help were given, immediately to make out a case for a Government grant?

It is difficult, indeed, to think at present of a scheme of Government assistance which unites the advantage of financial backing from Whitehall with the high advantage of developing an exceedingly technical industry on the very best commercial lines.

Again, the more closely such plans for State grants as have just been mentioned are scrutinised, the more they seem to offend the spirit if not the letter of the Convention. It is unnecessary to discuss the pros and cons of that Convention in order to feel that it is undesirable to throw open a question as difficult as it is unsettling.*

The Case for Non-imposition of an Excise Duty.—Unquestionably, there is not a little to be said for the Government following the course which is so congenial to the national inclination towards *laisser faire*, and doing nothing. For the Government to do nothing means, of course, merely to intimate to those concerned a decision to refrain from taking steps to impose an excise on sugar, and, at the same time, to leave the present import duty (of 1s. 10d. per cwt.) untouched. Without such an intimation, sugar manufacture would proceed under much the same Excise supervision as is imposed on distilleries and breweries. When the Maldon factory scheme was brought forward the Inland Revenue explained that an excise must be imposed, but that a rebate would be allowed to cover the additional expense involved in carrying on a factory under Excise supervision, and that this rebate would be made on a somewhat liberal basis and not upon an exact calculation of the expense involved. (*See* Appendix).

"The present sugar duty is nearly £2 a ton," said Lord Denbigh in the House of Lords. "No factory should be erected which is not capable of dealing with something like 5000 tons of sugar in the year, and, therefore, the policy of leaving things as they are would make a difference of some £10,000 a year to a factory; in other words, it would make all the difference between profit and loss."

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* "I oppose any subsidising, because we are bound by the Convention not to do it. Moreover, the West Indies would object unless they were also helped. The only legal help is the 2s. 6d. surtax, and if that were given, our sugar producing Colonies would have to receive the same preference."—MR. GEORGE MARTINEAU.

Without an excise, sugar would obviously be "protected" to the extent of 1s. 10d. per cwt., or about ¼d. per lb.

In support of this "Protection" it is possible to argue:

1. That a beet sugar industry would be almost in a category by itself.*

2. That it is not only the establishment of a new industry, but the production of a new raw material that is in question.

3. That in the case of the experimental factories it is necessary to start level in every respect with Continental factories, or not to start at all.

4. That the first factories must buy experience from which their successors must profit.

5. That until the farmers had acquired confidence and experience, roots would have to be drawn from a wide area, and if half the roots used by a factory working 50,000

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*"There is all the difference in the world between taking advantage of a duty which is now in existence for the purpose of helping an industry and completely changing your policy and putting on other duties which do not exist, simply and solely for purposes of protection. I do not myself see why there should be any further demand, for the simple fact that, with the exception, perhaps, of tobacco, there is no other article except sugar bearing a duty which is wholly imported from abroad, and which could be manufactured in our own country."—EARL OF DENBIGH.

IRISH TOBACCO.—For the case for and against treating beet sugar like tobacco in Ireland, *see* House of Lords Report, *Times*, March 22, 1911.

tons had to bear a charge of 3s. per ton for carriage, this would mean 3¾ per cent. on a capital of £100,000, a heavy burden on a new enterprise.

6. That in the event of a Continental war, a sugar industry in this country would prevent the price of sugar rising as high as it would otherwise do.

7. That if the sugar industry is going to be as advantageous to the country as it is contended that it will be, and if the sharp experience of 1910 and the influence of the authorities could somehow ensure that factory proposals should come up to a high standard of financial, commercial, agricultural, and technical efficiency, some sacrifice of strict fiscal principle might be made.

8. That, as Mr. Harold Cox has written, "the country is over-developed on the urban side; what is wanted is more agricultural and less urban industry."

9. That, as far as the argument that pleas on behalf of cheap sugar have been made on both sides in politics is concerned,* no legislation is proposed; the withholding of

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* THE SUGAR DUTIES.—"Sugar can hardly be so taxed that the poor shall not pay more than their fair share of taxation."—MILL.

MR. ASQUITH has described the sugar tax as "vicious in principle, burdensome in its incidence, unequal in its operation. . . . It is a bad tax, a tax which ought to be got rid of, and got rid of at the earliest possible moment."

"The main argument of the Liberal party has always been that they would not tax the food of the people or the raw materials of our industries. But the sugar duty does both."—MR. HAROLD COX.

In 1905, MR. CHAMBERLAIN said: "My object and my desire is to reduce the duty on sugar, and to give the whole advantage to the consumer."

"We ought to avoid taxes on the necessaries of life. The poorer people were, the more their food was confined to bread and tea."—MR. LLOYD GEORGE'S Budget speech, 1909.

an excise duty is to last for a short specified term of years only, sugar is very cheap; and we consume a great deal more than any other country in the world, and, on the score of hygiene, almost as much, perhaps, as is good for us.*

10. That altogether this seems to be one of the exceptional cases expressly provided for in the scriptures of Mill.†

Speaking on the eve of the introduction of his 1911 Budget, Mr. Lloyd George said the duty was an unfortunate duty, it was an oppressive duty, and one which undoubtedly interfered with a vital industry, but the abolition of the duty, now yielding three and a quarter millions a year, would create another difficulty in finding a substitute.

Speaking at Nottingham on November 17, 1910, Mr. Balfour spoke of reducing under tariff reform "those indirect taxes on tea and sugar."

"Most unwise statements with regard to the repeal of the sugar duties have been made by many prominent tariff reformers."—Lord Denbigh, February 10, 1911.

* Possibly this is a little sweeping. A year or two ago the *Spectator* wrote: "It is very common for a labourer's wife to buy regularly six pounds of sugar a week, and in addition probably at least a couple of pounds of jam, besides treacle and condensed milk. The total tax she pays on these articles may fairly be reckoned at not less than 4d. or 5d. a week." [Now, after the 1908 reduction in duty, 2d. or 2½d.]

† "The only case in which on mere principles of political economy protecting duties can be defensible, is when they are imposed temporarily (especially in a young and rising nation) in hopes of naturalising a foreign industry, in itself perfectly suitable to the circumstances of the country. The superiority of one country over another in a branch of production often arises only from having begun it sooner. There may be no inherent advantage on one part or disadvantage on the other, but only a present superiority of

The Other View.—On the other hand, in the discussion in the House of Lords, February 7, 1911, we have a former Unionist Chancellor of the Exchequer, Lord St. Aldwyn, declaring that neither the present Government nor any other Government is likely to promise not to impose an excise duty on sugar, and Lord Carrington stating definitely that, as far as the present Government is concerned, it "would have nothing to do with the old and exploded policy of dry nursing an infant industry." It is clear from the President of the Board of Agriculture's speech, from that of Lord Crewe, which followed, and from inquiries I have made, that the Government, so far from agreeing to refrain from imposing an excise duty, means to leave its hands free to reduce greatly or abolish entirely the import duty on sugar. Lord Crewe "doubted very much whether there was any prospect of sugar-growing in this country, even in favourable circumstances, becoming

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acquired skill and experience. A country which has this skill and experience yet to acquire may in other respects be better adapted to the production than those which were earlier in the field; and, besides, it is a just remark of Mr. Rae, that nothing has a greater tendency to promote improvements in any branch of production than its trial under a new set of conditions. But it cannot be expected that individuals should, at their own risk, or rather to their certain loss, introduce a new manufacture, and bear the burthen of carrying it on until the producers have been educated up to the level of those with whom the processes are traditional. A protecting duty, continued for a reasonable time, will sometimes be the least inconvenient mode in which the nation can tax itself for the support of such an experiment. But the protection should be confined to cases in which there is good ground of assurance that the industry which it fosters will, after a time, be able to dispense with it; nor should the domestic producers ever be allowed to expect that it will be continued to them beyond the time necessary for a fair trial of what they are capable of accomplishing."—MILL'S "Political Economy," Book V., Chapter X.

an industry which would compete, on the mere question of employment, with those great industries which depended upon cheap sugar,* and that was apart from the question of the interests of the consumer, which would be compromised for five years."

And that is the present position of the Sugar Beet Question.

Criticism of Beet Sugar Propaganda.—An assumption which appears to have been made by one distinguished speaker in the House of Lords may be corrected. "Several companies have been started," he said, and evidently felt that beet sugar manufacture was about to be undertaken at once, with or without Government assistance. There is

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* According to the census of production, the gross output (*i.e.*, the selling value or value of the work done) of the confectionery factories in 1907 amounted to £16,137,000. (The net output was £4,975,000, the materials costing £11,162,000.) Confectionery amounted to 3,833,000 cwt.; marmalade, jams, and fruit jellies to 2,712,000 cwt. The number of persons employed in England, Scotland, and Ireland was 60,735, plus 14,651 persons under 18. There are also the allied trades, and—bread and biscuit manufacturers and meat preservers, for example, produce between them £173,000 and £32,000 worth respectively, of confectionery, jams, and jellies—the employees at sweet shops to be taken account of. (In comparison, the following figures may be given: bread and biscuits, 110,168; brewing and malting, 85,222; tobacco, 37,456; grain milling, 36,207; aerated waters, 28,653.) Mr. Mathieson estimates a total consumption of 7,677,000 cwt. of sugar by biscuit factories, confectionery and fruit preserving factories, and preserved meat factories. The consumption by aerated water manufacturers would be additional.

It has been contended on behalf of the sugar using trades that they use a quarter of the sugar imported.

The figures in regard to the number of persons employed in the sugar beet industry in the Netherlands, where there are 26 factories, will be found in Chapter XV.

Sugar Factory at Leopoldsdorf, Austria

no prospect of a "sugar campaign" in an English factory just yet.

When such is the actual state of things, when it must be owned that a sufficient capital has never been got together for any proposed company, and the history of the beet sugar movement in this country may be represented by its critics as, to some extent, a story of unsuccessful finance and a great deal of speech-making, not all of which has stood the test of experience, there is some excuse for the President of the Board of Agriculture having taken the representations addressed to him less seriously than in other circumstances he would no doubt be disposed to do.

Nor is it less natural that the Cabinet should show little readiness to make, in the interests of an industry the precise value of which *in this country* is still to be proved, what it would be quite justified in contending might be represented by its opponents as an important breach in the fiscal system to which it is pledged.

If the advocates of factories could show beyond all question a considerable amount of capital ready to be invested, if no scrutiny could be too severe for their finance, if it were certain that they had got to know their facts, they might be entitled to demand that the Government should come more closely to grips with the subject, and, having explained what it cannot do, should proceed to state what it would be willing to do. As matters stand, it is to be expected that the authorities should feel most of all their responsibility to the public.

Attitude of the Board of Agriculture.—But this is not to say that they are unwilling to help if a wise method can be hit upon. About a year ago a junior representative of the Ministry (now Governor-General of Australia) intimated in the House of Lords that "this was precisely one of those cases where those interested might approach the

Development Commissioners with a view to seeing whether some assistance might be rendered." He was pressed in debate and it is possible that he went a little beyond his instructions. However this may be, to say hard things of the Board of Agriculture and of the Government is surely a mistake. The Board of Agriculture is not unsympathetic, and its horse-breeding scheme shows that it is not disposed to be hidebound. Putting it on the lowest ground, a Government which invented the Development Commission (and has just proposed to set apart further funds) has surely every inducement to do Development Commission work. The difficulty of Whitehall-place is to know how to help forward a beet sugar industry in a businesslike way and without running up against the Convention. Obviously, practical suggestions should come, not from the authorities but from the believers in beet sugar, and nothing that has a perfectly workable look seems to have been brought forward yet. "The Press and various farmers' clubs keep saying that the Development Commission 'ought to do something' for sugar beet," was the plaintive remark to me of someone of influence in the quarter in which "grants" are passed, "but no one seems to be able to say what that something should be."

Early in the year the Board of Agriculture decided to conduct a series of experiments in beet-growing at the Agricultural Colleges on larger areas than those on which tests have been systematically made hitherto. The details (*see* Appendix) were well thought out, and the results will be as useful as such experiments can be.

A Waste of Energy.—To talk about a duty is, in my opinion, unwise. It is not only to talk academically, but to help to make a subject, which has not too many serious students, a party matter. One of the great parties in the State would not dream of imposing a duty, and this party is in power. To wait till its successors could take up and carry through such a difficult matter* is not practical beet-sugar politics. The failure of the, in some ways, promising Sleaford venture, after a considerable capital had been raised, should be a warning against taking sugar factory proposals into the arena of party.

Everyone knows that many Free Traders are quite prepared to admit that if they knew when the infant industry would be admitted to be able to walk, and if it could be guaranteed that the nursery arrangement would be ended within a reasonable period, and would not lead to advantage being taken of the concession to weaken their case against Tariffs and Preference, they would be glad to act in the spirit of Mill. As it is, being human, like their opponents, they say that there are too many elements of doubt.

It cannot be overlooked that both political parties seem to be pledged to cheap sugar. At any rate, neither of them is likely to fancy going into a General Election with its opponent's placards proclaiming it The Enemy of Cheap Sugar!

As to the abolition of the existing duty altogether, which is talked of, political experience hardly suggests that it will be hindered by representations—well-founded or ill-founded—to the effect that 1s. 10d. per cwt. is not even $\frac{1}{4}$d. per lb., and that if the duty is abolished the middleman, not the consumer, will alone benefit.*

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* MR. BALFOUR AND AN INFANT INDUSTRY.—Speaking in April, 1910, MR. BALFOUR said: "There cannot be the smallest doubt of the value of this form of industry to our rural population, as it gives employment at the very time of the year when work is least in demand for other operations connected with agriculture. I should certainly desire to support any practicable scheme which might encourage the early stages of this infant industry."

Surely the statement that has been made that the industry "distributes its employment well over the year, many workers finding employment both in the field and factory" is an exaggeration. Do more than 10 per cent. find such employment?

The Practical Thing.—The deputations of a public-spirited British Beet Sugar Council (with no funds worth mentioning, needless to say), are all very well, but as a distinguished public servant humorously inquired the other month: Was there a National Taxicab Council haranguing the authorities before the advent of taxicabs? The pressing need does not seem to be for more speeches, for more newspaper or review articles, or for more experimental plotting. What is wanted is that a few honest, hard-headed business men, with agricultural interests, who have plumbed the depths of their ignorance as to

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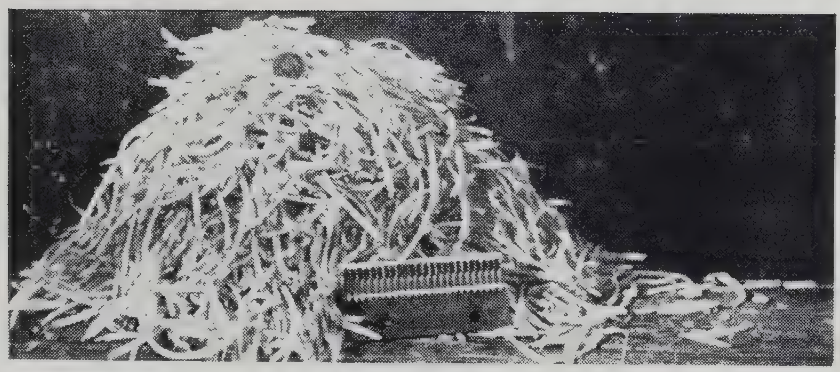
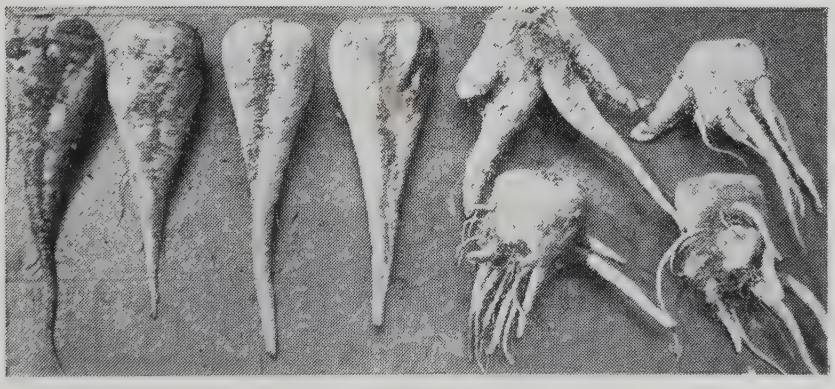
* WOULD THE POOR BENEFIT BY A REDUCED DUTY?

[No.]	[Yes.]
The duty is 1s. 10d. per cwt., or three-sixteenths of a penny per lb. The masses buy their sugar by 1lb. and $\frac{1}{2}$lb., so that in order to let them benefit by the abolition of this negligible amount the Chancellor will have to issue some new fractional coinage representing $\frac{3}{16}$d. and $\frac{3}{32}$d., so that the grocer can make the reduction. In this way and no other can the working man derive the slightest benefit, and the country will be the poorer in revenue by nearly four millions. On the other hand, if the duty is left, the working man will benefit by the amount of extra employment which will be created by the erection and working of factories.—F. F. KEMP.	Some of the very poor buy their stores from hand to mouth in very small packets, and so frequently lose the advantage of price reductions, but it certainly is not the case with most housekeepers. We will trust competition to adjust the price with fair benefit to the ultimate consumer, if it is left to operate freely. When Mr. Gladstone reduced the tea duty to 6d. per lb. the price soon fell much more than the abatement of taxation, for the reason that at the cheaper rate the demand expanded enormously, and the supply kept pace with it. Probably it will be the same with the abolition of the sugar duty.—*Yorkshire Observer.*



WET SLICES AND ONE OF THE KNIVES USED IN THE SLICING MACHINE AT THE HOLLANDIA FACTORY

The coin introduced to illustrate the size of the slices is a shilling. The shape in which the slices are cut has been carefully thought out in order to expose as large a surface to the water as possible, and to prevent the slices lying alongside one another



WELL SHAPED AND BADLY SHAPED BEETS
(Photographed at a Dutch factory)

sugar manufacture, should get together and carefully examine the figures which have been produced bearing on the prospects of factories, and then, if their business experience leads them to be impressed by these calculations, take the very best technical advice and arrange the preliminaries for the formation of a thoroughly sound company.* It is saying very little for such an enterprise if, with a country full of capital, it could not rely on attracting the funds it required.

The Way we Have in England.—That is surely the way in which things have usually been done in this country. State assistance in the initial steps of a beet sugar industry may or may not have been worth while on the Continent —I have set out the pros and cons—and may or may not be desirable and practicable in this country—the reader will form his own opinion on the facts which have been placed before him—but it is only honest to admit that we have no recent tradition in England of such a way of establishing industries. Every new industry in this country has to bear the yoke in its youth, and, if all that is said by the supporters of a beet sugar industry be true, that industry should be able to "thole and win."

Criticism of the Government.—Since the gist of some of these paragraphs appeared in the *Times* and the *Field* the indomitable Lord Denbigh has got his National Beet Sugar Association to work somewhat on the lines suggested under the heading "The Practical Thing,"† and the British Beet Sugar Council has been to the Development Commissioners to ask for a grant for further experiments and propaganda work. (The Commissioners said they would like to think the matter over.) The National Association's practical efforts to inform itself (by means of an English investigator touring on the Continent) and its admission that before a factory can be started there is a very large and very complicated agricultural and commercial problem to study, may be warmly applauded.

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* It should not be necessary to assure the public that there is no room for company promoting expenditure; the capital of an experimental company must be raised, as it must be expended, on the soundest lines.

† "The Directors have formed this Association in order to collect information, work out the necessary details for developing the industry, employ experts for the examination of suitable land and

But there is a circumstance which a historian of the Sugar Beet movement would be less than candid if he failed to record. For some years past the Government has been upbraided for hesitating to lend its countenance—for that is what any sympathetic action would have meant—to appeals to the public for factory capital. It has been my duty to demonstrate in these pages—and the Association and the Council will hardly need to spend much money to find out—that these appeals must have been based on data as inadequate as they were misleading. Can it be gainsaid that the Board of Agriculture and the Development Commissioners have done good service by insisting on carefully considering the situation before taking any steps in the direction of monetary assistance?

With regard to that assistance, everybody recognises

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the instruction of farmers in the scientific cultivation of the sugar-beet, and to collate and summarise experience. In the light of the knowledge so acquired, the Association would be prepared to assist in the erection and organisation of factories, and the raising of the necessary capital. The Association would retain or acquire such interest as might seem desirable in the resulting undertakings."—NATIONAL SUGAR BEET ASSOCIATION PROSPECTUS.

A covering circular states that one object of the Association would be to "guarantee growers against loss where there is no free market."

that when, as in the present case, there is every indication of interest in the subject on the part of the authorities, it is no very difficult matter for an official "No" to modify itself into "Yes." The condition is not only that a suitable method of helping shall be suggested, but that *the case for help shall be completely made out.* Is it unreasonable to expect that before a claim, which has been supported by so much wild advocacy, is given a distinctly national character, it should be clearly shown to rest upon a sound basis of facts?

As to a suitable method of helping, I may recapitulate:

1. The position of Great Britain, not only as a signatory of the Brussels Convention, but as a prime mover in bringing about that international agreement, makes Government assistance to any commercial sugar undertaking extremely difficult.

2. To ask for Preference is not, with a strong Free Trade Government in power, practical politics; is to make of the sugar beet movement a party question; and is in opposition to a large body of opinion that the method of Preference is, in any case, an undesirable way by which to establish a new industry in England.

3. There remains the proposal for which there is, *per se*, a great deal to be said, to allow the sugar duty to stand for five years without imposing an excise of equal amount. The difficulty is to determine what is actually involved in such a proposal. It seems a pity that those who say that they would be content with a non-imposition of excise for five years should leave anything undone which might serve to demonstrate that their proposal means no more than what it says. Why do not the National Sugar Beet Association and the British Sugar Beet Council at least volunteer an undertaking that if the duty is retained and the excise is not imposed for five years, they will not

agitate directly or indirectly for the continuance of this arrangement, and will dissuade those interested in the sugar beet industry from so agitating? If this seems impracticable, may not the proposal be regarded as impracticable too? If the course indicated were adopted, many Free Traders who would like to see the experiment of beet sugar factories tried in this country, and those who do not profess to know anything about sugar beet but have pledged themselves to the abolition of the sugar duty in the interests of a "free breakfast table" might be expected to take a more favourable view of the plea for the non-imposition of an excise.

Until such an undertaking is forthcoming it is natural that those who are distrustful of Government assistance should fear that the five years proposal would lead to a situation in which hardship might well be inflicted by the non-continuance of the arrangement: that it might be like lending a cripple crutches for five years, on his confident assurance that he would be able to walk at the end of that time, and then at the end of the term, when he was not able to walk, but was much nearer walking than he had been, ruthlessly taking away his supports.

They may be excused for asking whether those who have closely studied the remarkable Japanese experiment in Formosa are likely to say that the results of a State-aided sugar industry are wholly gratifying. They will undoubtedly draw attention to the situation in the United States, where, even with a protection of 7s. per cent.—

(1) Beet-sugar making, after several years' fostering, is making very moderate progress;

(2) The leading American sugar journal has just come out with a cartoon representing the sugar factories protected from a pile of barrels of foreign sugar by a tariff wall, and Uncle Sam saying anxiously to a Congressman:

"Don't monkey with that wall, or it will fall in and crush these factories";

(3) Even with Louisiana, Texas, Cuba, Porto Rico, Philippines, and Hawaii cane to draw from, the United States imports about a quarter of a million tons of sugar in the year.*

They will point out that the Dutch apostles of sugar beet come themselves from what the "Statesmen's Year Book" ranks as "a free trading country." And they will not fail to quote the representative of the Dutch company which is working for the establishment of a factory near Norwich when he says: "Even if we have to pay an excise on sugar made and consumed in England, we still have the advantage of the costs of shipping, landing, and freight, which come on all the sugar imported by your Continental competitors. This means that we have already a saving of about 15s. per ton on our home-made sugar." It is certainly the case that an English factory would have no difficulty in getting rid of its product locally.

I have the best reason for saying that if a factory were built, and were being managed on sound lines, and a difficulty arose in obtaining sufficient beets, the Board of Agriculture would be prepared to do educational work to encourage farmers to enter into contracts.

The Outlook.—The results of the beet harvest of Mr. Cohen's syndicate in East Anglia at the end of 1911—the skilful and enterprising preparations for which have deserved a large measure of success—will furnish some supplementary data as to commercial cropping. When carefully sifted, and weighed alongside the disinterested reports to be prepared by the Agricultural Colleges on the work they have been simultaneously doing, and added to the information brought together in these pages, we may be in a somewhat better position to form an opinion on the prospects of a Sugar Beet Industry.

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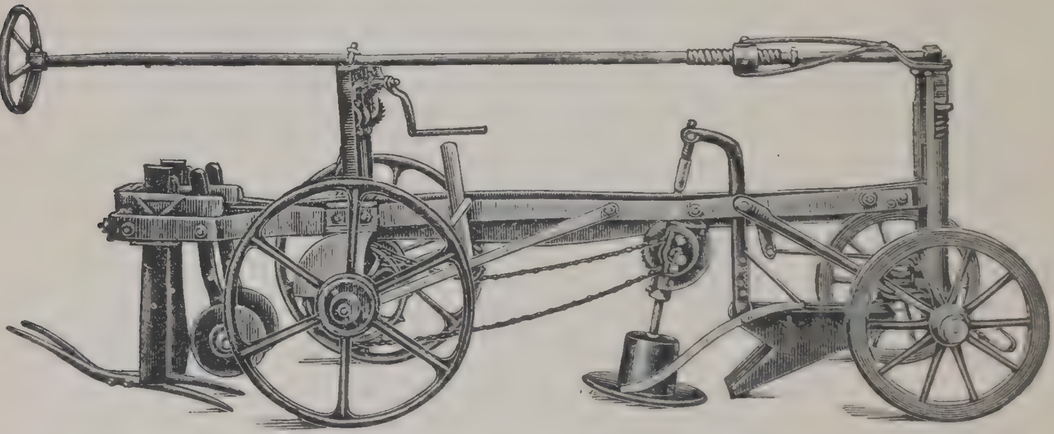
* The percentages are as follows:—Home products: Beet, 13·32; cane (Louisiana and Texas), 12·58; maple, ·34; total, 26·24. Hawaii and Porto Rico (cane), admitted duty free, 22·07; Philippines (cane), admitted free (up to 300,000 long tons annually), 1·44; Cuba, admitted under a preference of 20 per cent., 43 82; foreign sources (nearly all cane), 6·43.

But none of the work done this year can really tell us very much that we do not know or suspect already, or take us very far.

There are those who in the autumn may take another view. Instead of endeavouring to concentrate the attention of all concerned on the possibilities of a sound experimental factory, they may insist that nothing remains to be done but to issue prospectuses for factories for every likely county. In that event some of the facts and figures—and, it may be, some of the history!—in this book may save many public-spirited and well-meaning people from losing their money.



A German Beet Harvester and Beet Topper for dealing with one row of roots

There is an American machine which harvests and tops beets very much in the same way as the German and French machines.

AN ADDITIONAL CHAPTER

NOTES OF VISITS TO GERMAN AND FRENCH SUGAR BEET FARMS

By R. N. DOWLING, N.D.A.,

Agricultural Adviser to the National Sugar Beet Association
(Formerly Lecturer in Agriculture, Hunts C.C., and Wye College, Kent).

[Below will be found a condensation of the Report of investigations made in Germany and France by Mr. Dowling, to which he has kindly added his Conclusions, based on the considerable range of first-hand data collected. I have appended here and there, as footnotes, extracts from an English version of the Report of a visit paid by a party of French beet growers to Germany, Austria, and Belgium, in 1910, which Mr. Sam Mendel has been good enough to send me.—H. C.]

Farm near Hildesheim, Hanover.—500 hectares: 375 arable, 50 grass for hay and 75 wood and poor grass. Cropping: 100 wheat, 100 beet, 70 rye, 10 potatoes, 70 oats, 25 fodder, &c.; total, 375 hectares, arable. Stock: 30 to 50 working oxen, 30 fatting beasts, 25 horses, 600 fatting sheep, 400 ewes with lambs, 3000 swine, including sows, sucking pigs, boars, stores, and fatting hogs. Number of workpeople: German, 50 regular hands; Russian Poles, 50 to 60, mostly women.

Rotation: 1, rye; 2, beet (two years running on new land); 3, oats; 4, potatoes; 5, wheat; 6, beet.

Yields per acre: Sugar beet, 13 tons washed and topped roots; wheat, 46 bushels; oats, 48 bushels; rye, 68 bushels; potatoes, 8 tons, 2cwt., ware.

Dried pulp, after the usual 5 per cent. allowance returned free, 5s. per cwt. Estimated value of leaves, 4s. per cwt. when ready for use, *i.e.*, after having been in clamp.

Estimated cost of production, inclusive of rent, rates, taxes, manures, &c., £12 10s. per acre, or, less rent, rates and taxes, £9. Return: 13 tons at 25s. £16 5s.; therefore net profit, after deducting all costs, was £3 15s. per acre. I afterwards ascertained that the average price paid by the factory is rather less than above. Dried pulp and leaves in form of silage were being fed to oxen, fatting beasts, cows, and sheep.

Gangs of Polish women, 35 in number, to one German overseer, as often elsewhere. Women arrive in March and stay to November or December. They hoe wheat and spring corn, side-hoe and set out beet, and do haymaking, &c., lift beet, and help with threshing. On May 30, bunching (chopping out) and singling (by children) and side-hoeing were in full swing. Rows, 14in. apart; beet, 9in. to to 12in. apart. Hoes, 7in. blades, and handles as in England, 4ft. 6in. to 5ft. in length. Polish women paid 1s. 3d. per day ordinary work; 6d. extra when hoeing. Housing, wood for firing, potatoes, flour, &c., in addition to wage. Inclusive cost, about 2s. 6d. per day. German women paid 1s. per day; Polish women work from 5 a.m. to 7 p.m.; German children paid 1s. to 1s. 2d. per day for singling. Soil: mostly fairly light 2-horse land and a fairly good loam; some rather stiffer.

Farm near Gandersheim, Hanover.—Friable loam, 250 hectares: 85 hectares grass, 30 wheat, 30 rye, 30 beet, 45 oats, 8 potatoes, 22 fodder and barley. Stock: 18 horses, 6 draft oxen, 20 beasts for fatting, 35 cows in milk, 200 sheep and 160 lambs, 60 sows, 700 other pigs. Rations, sheep in winter: beans, $\frac{1}{9}$lb.; maize, $\frac{1}{9}$lb.; bran, $\frac{1}{9}$lb.; beet-pulp, $\frac{1}{2}$lb.; mixed, and $\frac{1}{3}$lb. of the mixture fed per day. Fatting beasts per day, per animal: 2lb. cotton meal, 2lb. bran, 2lb. crushed oats, 3lb. dried pulp. Horses: 6lb. oats, 2½lb. molasses mixture (5s. per cwt.), 1lb. dried pulp (5s.), 2½lb. dried brewers' grains, (6s. 6d.). 2lb. schlempe (6s. 6d.); 20lb. per day. The inspector preferred a good oat and chaff mixture, but the foregoing mixture is more economical Cows in milk: 3lb. cotton meal, 3lb. bran, 2lb. dried grains, 6lb. dried pulp, for one day, fed in two feeds. Breeds: Belgian horses, Dutch cows, Oxford down rams crossed on Rambouillet ewes, large and middle white Yorkshire pigs.

Another Farm near Gandersheim.—Stiffer land; 350 hectares. Large number of Friesland cows; milk sold for 7d. imp. gal. wholesale.

Yield: Average 10 tons per acre; smaller yield than usual. Farmer stated that if the factory paid 20s. per ton, he considered he got his expenses back clearly. It is agreed that the price shall not be lower than 20s. per ton. He is a shareholder in the factory, and undertook to grow 120 hectares for fifteen years.

Farm near Göttingen, Hanover.—Light friable loam. Horse hoes, usually drawn by oxen, were being used to do seven and five rows at a time each. The coulters are fitted with V-shaped 9in. blades. Hoe fitted with fore-carriage on the Suffolk drill principle, and followed by a wide handled harrow, fitted with sharp pointed tines to turn weeds out that get covered with earth.

Another Farm near Göttingen.—Same soil. 300 morgen beet, 300 morgen wheat, 100 morgen oats, 30 morgen beans, 50 morgen rye, 120 morgen fodder crops, &c.

Rotation: Beet, 300 morgen; wheat, 300; oats, rye, &c., 300. Beet once in every three years.

Stock: 12 farm horses, 20 draft oxen, 105 cows. Steam plough and tackle.

Rations per head per day.—Farm horses: 15lb. oats, 2lb. beans (when working hard), 9lb. hay, 1lb. to 2lb. dried pulp. Cows in milk: 4¾lb. cotton meal, 2lb. bran, 8lb. dried pulp, 8lb. leaves and tops, 8lb. oat straw. Working oxen: 8lb. to 10lb. dried pulp, 15lb. oat straw, 4lb. bean meal, 2lb. to 3lb. cotton meal, 3lb. bran, little hay, per head, per day.

Milk sold at 6d. per gal., wholesale.

Beet yield, 13 tons per acre washed and topped; mangels ("Futter Rübe"), 48 tons, 10 cwt., not washed or topped. Farmer stated that he was a shareholder in factory, and that the roots were bought by weight, and not by sugar content. This appears to be unusual. His contention was that, by growing a root with a lower sugar content but a larger yield per acre, more sugar was obtained. Factory pays carriage (15 kilomètres by rail), about 1s. per ton. Deductions for dirt average 33 to 35 per cent, but has been 50 per cent. Average price for roots at factory, 25s. per ton. Farmer said his outlay is met by 20s. per ton, but then not much profit, because he has small yield.

Russian Poles: Forty women, ten men. Wages: women, 1s. 3½d; men, 1s. 9d. to 2s. All get 25lb. potatoes per week; 1 litre of milk between three women daily; housing, firing, light, &c. When too wet to work, no wages. Piecework: 5s. to 6s. per acre for side hoeing, 2s. 6d. to 3s. chopping out. This is very much the same as in England. German men get 2s. to 2s. 6d. daily (harvest 3d. more). German regular men get house, about ¾ of an acre of land, and £40 a year. Children spend the morning at school, and in the afternoon come and work at singling beets. They get 5½d. per afternoon each.

FACTORY FARM NEAR ALLSTEDT, SAXONY.—Light dusty soil. Rows 14 in., and plants only 6 in. apart; these were the closest seen anywhere.

I came to some beet that were hoed across the rows by hand. An implement had made faint lines, about 3ft. apart, by means of four wheels, thus enabling each worker to keep straight and to do an equal share of work. The implement was fitted with four little wheels, and was pulled by hand.

FARM, ARTERN.—Light friable loam.

Beet, 300 morgen; winter wheat, 120; spring wheat, 110; barley, 90; rye, 75; peas, 50; oats, 45; beans, 30; potatoes, 25; grass, fodder crops, &c., 355; total, 1200 morgen.

Rotation: Beet, oats, wheat, beet (once in three or four years), barley, potatoes or peas.

Stock: 20 farm horses and 2 saddle, 10 draft oxen, 20 fatting beasts, 30 cows, 600 sheep, 30 swine, 30 calves.

Drills used with 10 coulters, 14in. apart. Seed: 29lb. per acre. Factories always supply seed, and stipulate that it is used; sometimes, however, the farmer has to pay cost price.

Manuring per morgen: 1½ cwt. superphosphate (17 to 19 per cent. phosphoric acid), 1cwt. kainit (14 per cent. potash), 2cwt. nitrate of soda.

Russian Poles: Sixteen men and twenty-four women. Cost of cultivation, without rent, rates, or taxes, £7 10s. per acre, or, with rent, £10 10s. Value of land, £90 per acre; rent, £3 (one of the lowest met with).

Yield: 16 tons per acre. Factory pays on an average 24s. Thus we get:

Yield, say, 15 tons at 23s. =	£17	0	0
Cost, including rent, rates, taxes, freightage, &c., say	12	0	0
Net cash profit per acre	£5	0	0

Beet raised with handfork, although more expensive than machine, because of damage to leaves by bullocks. Where steam lifting is possible it is used, and does less damage than handwork, it is said.

Small farmers undertake to lift and top roots for the leaves, which seem to be worth about £1 an acre.

Chopping out, 3s. per acre; 1st side hoeing, 3s.; 2nd, 4s.; 3rd, 3s. 6d. Horse hoeing as required.

After chopping out is finished, the school children start singling in gangs of from thirty to forty. Children who are old enough to do two rows at a time get a 1s. per day; those who do one row get 7d. per day. Cost of lifting by hand, topping, and putting into heaps (three to the acre) and covering same with earth, 16s. per acre, piecework.

KLEIN-WANZLEBEN, NEAR MAGDEBURG.—9880 acres. Estimated cost of cultivations per acre:

Loading dung—6½ loads	£0	1	6
Carting dung to field and putting into heaps	0	9	0
Spreading dung	0	0	9
Loading, carting, and putting lime into heaps and later on spreading	0	2	0
Steam-ploughing, 12in. deep	0	12	0
Heavy harrow (10 acres a day with 2 horses)	0	1	6
Light ,, (ditto with 1 horse)	0	0	7½
Broadcasting artificials with machine at 2 different periods (9½d. each time)	0	1	7
Two men helping with above	0	0	3½
Twice cultivating 7·4 acres per day at 2s.	0	4	0
Harrow	0	1	6
Flat roll, 12 acres a day	0	1	0
Harrow	0	1	6
Light roll	0	0	9½
Light harrow	0	0	3
Drilling and harrowing with 2 men	0	1	6
Foreman (casual supervision when drilling)	0	0	1½
Hoeing: Four times machine hoeing with bullocks at 7d.	0	2	4
Four times 2 men with above	0	1	6

Bunching or chopping out by hand...	£0	2	3
Singling, with children	0	3	0
Twice hand hoeing	0	9	6
Harvesting: Lifting beet by steam (25 acres a day)	0	10	6
Topping and putting into heaps	0	19	6
Loading roots (14 tons per acre)	0	3	0
Carting roots 3½ miles (? per light railway)	0	7	0
Carting leaves (10 tons leaves to 14 tons roots)	0	0	9
	4	19	3
Four tons dung at 5s. (this no doubt is supplemented by green manuring)	1	0	0
One ton saturation lime	0	2	0
Three cwt. nitrate of soda	1	10	0
Two-and-a-half cwt. superphosphate at 2s. 6d.	0	8	9
Total cost of cultivations with manure	£8	0	0

(Rent, rates, taxes, and green manuring not charged for.)

Rations at Klein-Wanzleben per head, per day.—Farm horses: 16lb. oats, 4lb. bran meal, 1lb. bran, 1lb. linseed cake, 4lb. molasses, 4lb. hay, 10lb. green clover. Working oxen: 1lb. bran, 1lb. pea meal, 2lb. kibbled maize, 6lb. molasses, 6lb. dried slices. Sheep: ¼lb. maize, ¼lb. poppy seed cake, ¼lb. rice meal, ¼lb. kibbled barley, ¼lb. molasses, ½lb. small grain, ¼lb. dried slices, 5lb. beet leaves from silage clamp.

Seed sown, 25 to 30lb. per acre on good land. Distance between the rows, 16in.; between plants, 10in., 40,486 plants to acre. Dr. Rabbethge maintains that, within reason, a fair sized root does not lower the sugar content per acre. As a rule, however, the planting seems to be 14in. between the rows by about 7in. to 10in between plants. On the stiff soils to the west of Brunswick, 15in. and even up to 19in. between rows, and 12in. between plants.

Yields: Beet, 14 tons 10cwt. per acre; winter wheat, 50 bushels of 63lb. to the acre; barley, 52 bushels of 56lb. to the acre.

Factory pays freightage on roots. Dirt: Deduction averages 25 per cent.

Wet slices are preferred by farmers, and Dr Rabbethge says: "A better feeding value." Wet slices supplied to half weight of root sent in; dry, 7 wet to 1 ton of dry (85 per cent. to 90 per cent. dry matter).

Two steam diggers, fitted to lift two rows, lift twenty-five acres a day.

Wegeleben Factory.—Has huge pits for the storage of wet pulp, roughly, 30ft. wide by 30ft. deep, and 100ft. long. As there is a gravel subsoil the excess of water is able to get away, and leaves the pulp caked up with a much smaller percentage of water. They do not possess a drying plant in consequence.

During my visit to France I went through the departments of Pas de Calais, Somme, Oise, Aisne, and Nord, much of the country was traversed on a bicycle. Details as to the cost of cultivation were so similar to those in Germany, that the latter may be safely taken for comparison with English costs.

CONCLUSIONS

German Soils.—The best sugar beet soil in Germany is the easy working and friable, dark coloured sandy loam, which is free from stones. This soil is seen around Magdeburg, but it is also present between this place and Halle and other districts. It is a fresh-water alluvium, and is the result of drifts or washings from the Harz mountains. It varies as to quality, and on anywhere but low-lying country the crops are apt to suffer badly from drought. This was plainly seen at Wolmirstedt, near Magdeburg, where all the crops had suffered severely from want of rain during the spring of 1911. Barley was forming ear and turning yellow, although the straw was only one foot high. The beet crop had stood the effects of the drought better than any other crop. This, no doubt, was due to its deep rooting. Beet are also grown on light sandy and clay soils. Those seen around Allstedt are a fair example of the former, and those to the west of Brunswick, at Wierthe, of the latter. The advantages or disadvantages of either depend on the prevailing climatic conditions. In this spring of drought, the crops on the clay were looking much better than those on the sand. Very little chalk soil was seen under beet cultivation. Cultivations are comparatively easy on the light, friable loam, and can be carried out practically during the whole year. The humus content is kept up by ploughing in farmyard manure supplemented by green manure. In some districts the soil had the appearance of being acid, but the continued application of factory lime has prevented harm from this source.

French Soils.—Beet are cultivated on thin chalk soils, very light friable sands, mixtures of clay and sand, alluvium, and sandy loams. The chalk soils are chiefly met with in the Pas de Calais. The light sands can be seen in many districts, but a good example is round Soissons, and between Soissons and Laon (Aisne). Sandy loams are present at Aulnois, near Laon, and in many other parts, for example, Province Oise and round Cambrai (Nord). The heavy land is situated in the neighbourhood of Valenciennes (Nord). Beet are cultivated on soils in some parts that are eminently unsuited to it, and this is probably due to the fact that the beet area in France is restricted. The yield of beet and sugar in France is not so good as in Germany. This is probably due to the fact that, on the whole, the French soil and cultivation are inferior.

Comparisons with English Soils.—It struck me that the best of the German soils had not the "body" of our English soils, and that the results obtained were largely due to past cultivation and constant ploughing in of green crops and application of farmyard manure. In fact, I feel confident that the average English soils will more than equal the yield obtained on the German loams.

The beet growing soils of Germany are certainly superior to those of France, but I have formed the opinion that, taken as a whole, the probable beet root areas of England are superior to those of either Germany or France. We have large areas of land suitable, and any land that will grow good mangels will grow good beet, providing it is not too wet, marshy, or badly drained, is not very stiff, retentive clay—this because of the expense—or, perhaps, peaty soil. It is found on peaty or moorland soils the sugar content is lower. Sufficient depth is essential.

Rotations.—Neither in France nor Germany were any cases met with where beet was grown continuously on the same land. On one large factory farm near Péronne, in France, wheat and beet were grown alternately. This statement does not mean that beet cannot be grown continuously on the same land, but that in the ordinary course of farming it is found wiser to follow a rotation. The rotation in Germany is often based on our Norfolk four-course rotation, the beet crop being followed by a spring crop, barley or oats, or, where they have light, easily worked soil, by wheat. Part of the beet area is sometimes given to potatoes. The rotation in France is generally a three course one, and in some cases one-half of the beet area is given to fodder crops. The rotation is—1, beet; 2, wheat; 3 oats. The best soils are always reserved for beet. Thus we see that beet occurs every three or four years in Germany and every three years in France.

Cultivations and Manuring.—The cultivations of the beet crop have been reduced to a science in Germany. They are practically uniform in all districts. Details are given in the specification as to cost.*

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* Beets generally receive the following manure: (*a*) 12 tons to 16 tons farm manure, 4cwt. to 5cwt. kainit or 150lb. to 180lb. potash salts at 40 per cent., 2cwt. nitrate of soda, 2½cwt. to 4cwt. of superphosphate at 18 per cent. (*b*) If beet follows on clover, lucerne, peas or beans it is given: 2½cwt. to 3¾cwt. superphosphates at 18 per

Farmyard manure is used at the rate of from 12 to 16 tons to the acre on an average, but in France I have come across as much as 25 tons. It is usually ploughed in in the autumn, but in spring on light sandy soil. In one case I saw long dung being ploughed in 9in. deep on April 30, in preparation for beet on a light sandy soil in France. This was much later than usual. In Germany green manuring is resorted to to a great extent, and when such is the case a much smaller quantity of farmyard manure is applied. The green manuring consists in growing and ploughing in leguminous crops, such as lupins, peas, beans, clover, &c., or cereals, such as rye and barley, with perhaps a mixture of tares. On light soils these are generally ploughed in in the spring, and on heavy soils a mixture of peas or beans with vetches are taken as a catch crop after the rye or early barley, and ploughed in in the autumn. The foregoing organic manures are supplemented by dressings of nitrogenous, potash, and phosphatic manures, details of which are given elsewhere.

Sowing.—The average drilling on good soil appears to be about 30lb. to the acre. This apparently high quantity is used to guard against slow or poor germination and to ensure a good plant. It has been stated that in this country there might be a difficulty in getting good seed. Anyone who has seen the enormous warehouses and stores of seed at the establishments at Klein-Wanzleben will realise the absurdity of such a supposition.

The average distance between the rows in France and

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cent., 5cwt. to 6cwt. kainit or 2cwt. potash salts at 40 per cent., 1½cwt. to 2½cwt. nitrate. (c) If it follows on green manure, it is given: 2½cwt. to 3½cwt. superphosphate at 18 per cent. (for light soils, part of the phosphoric acid can be given in the shape of basic slag), 5cwt. to 6½cwt. kainit or 2½cwt. of potash salts at 40 per cent., 1cwt. nitrate.—French Report.

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Germany is from 14in. to 16in. on light soils, and from 16in. to 19in. on heavy soils, and the distance between the plants in the row is from 7in. to 10in. on light soil and from 10in. to 14in. on heavy soil.

Labour.—The wages paid will be seen to be practically the same as in England, both for day and piecework.* The wages are partly paid in kind, but, after careful inquiry from many farmers, I found that 2s. 6d. a day for female labour was the recognised allowance. In my opinion there should not be much difficulty in obtaining unskilled labour for work in this country. There are at present many hundreds of women and men at work in England among peas, strawberries, hops, and fruit. Providing they were offered a fair wage and properly looked after, there is little doubt that as many as were wanted could easily be obtained from London for the whole summer season. It is a question of organisation, and to those who are used to such labour—in Kent and other counties—it presents no difficulties. On many farms growing market garden produce a great deal of casual labour arrives with potato planting and remains until after harvest.

The work of hoeing is simplicity itself and anyone could pick it up most easily. Speed comes with practice. The women look healthy and happy, and it would seem to offer a grand opportunity of emptying London and other places during the summer of the squalid poor. Such labour is invaluable for hoeing other crops and in many ways, and consequently a smaller proportion of regular hands are kept for the amount of work done than could otherwise possibly be the case.

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* "Labour was scarce in all the beet districts visited [in Germany]. In certain parts of France where the beet is cultivated, labour is becoming increasingly scarce, and it will be necessary either to diminish the area devoted to it or to devote less time to the tilling operations. It will probably end in the importation of Polish labour, but it takes time to organise such a system."—French Report.

Implements.—There should be very little difficulty in adapting our drills, horse hoes, and other implements to the use of beet culture. In France, many factories supplied a small drill, very much like our mangel drill, fitted with three delivery spouts 16in. apart. On a farm near Arras the drill in use was made exactly on the Suffolk principle with the forecarriage steering gear, the six coulters being 17½in. apart. This drill was doing 10 acres per day with two horses. The hoe tines were fitted with V-shaped blades, each being 9in. in length. The root lifters are described elsewhere.

Stock.—From the foregoing figures it will be seen that large numbers of stock are kept on the farms, including horses, draft bullocks, fatting beasts, ewes, fatting sheep, milch cows, and pigs. The head of stock kept per acre is greater than in England. This is particularly interesting when we consider that in many parts of Germany and France no roots in addition to beet are grown.

Wet and Dry Beet Slices.—The English root crop is entirely replaced by the wet or dry slices and the leaves and tops, which are stored like our mangels. The slices-fed beasts and sheep were firm to the touch and looked well. It was impossible to detect the taint from the slices in milk or butter from cows fed on slices together with other food.

In Germany the dry slices containing 6 to 7 per cent. of sugar are generally used. (The weights are given in the mixtures already reproduced.) The slices are soaked for 12 to 24 hours before using and largely increase in bulk. They are then mixed with chaff in the same manner as sliced roots in this country, and are fed with cake and other foods. In France the wet slices are universally used.

They are carted from the factory, and stored in pits, being pressed and covered with earth in a similar manner to our mangels. They are fed in very much the same proportion as mangels.

Molasses.—In France, as a rule, the molasses are used in the production of alcohol. In Germany they are fed to stock. They are supplied by the factories absorbed by peat moss, chaffed straw, millers' offals, slices, or palm nut meal. Molasses are also watered down and sprinkled over food in the same way as we used to employ agricultural treacle. The price and feed value varies according to the nature of the absorbent used.

Cost of Production.—In Germany, the average cost is from £8 to £9 10s. per acre, exclusive of rent, rates, and taxes, and in France about the same. It will be seen that the cost of production is not so large as is generally supposed. Lifting, topping, and putting beet into heaps averages from 16s. to 25s. per acre. The rent of beet farms in Germany averages from £2 10*s.* to £4 an acre, whereas in England the rent runs from £1 to 35s.* Wherever good lands occur, beet are grown with the result of higher values of land and higher rent. Near Soissons, in France, before beet culture, the land was, in places, practically a barren waste. Since the introduction of beet it has a ready sale. In Germany, land values have increased from 20 to 30 per cent. during the last thirty years, and the selling value is from £60 to £100 per acre.

Returns.—(For figures, see pages 360, 361, 363, 364). In France, most farmers are satisfied with a small profit. In Germany, on good farms, the average yield may safely be taken as 14 tons. As the average cost of

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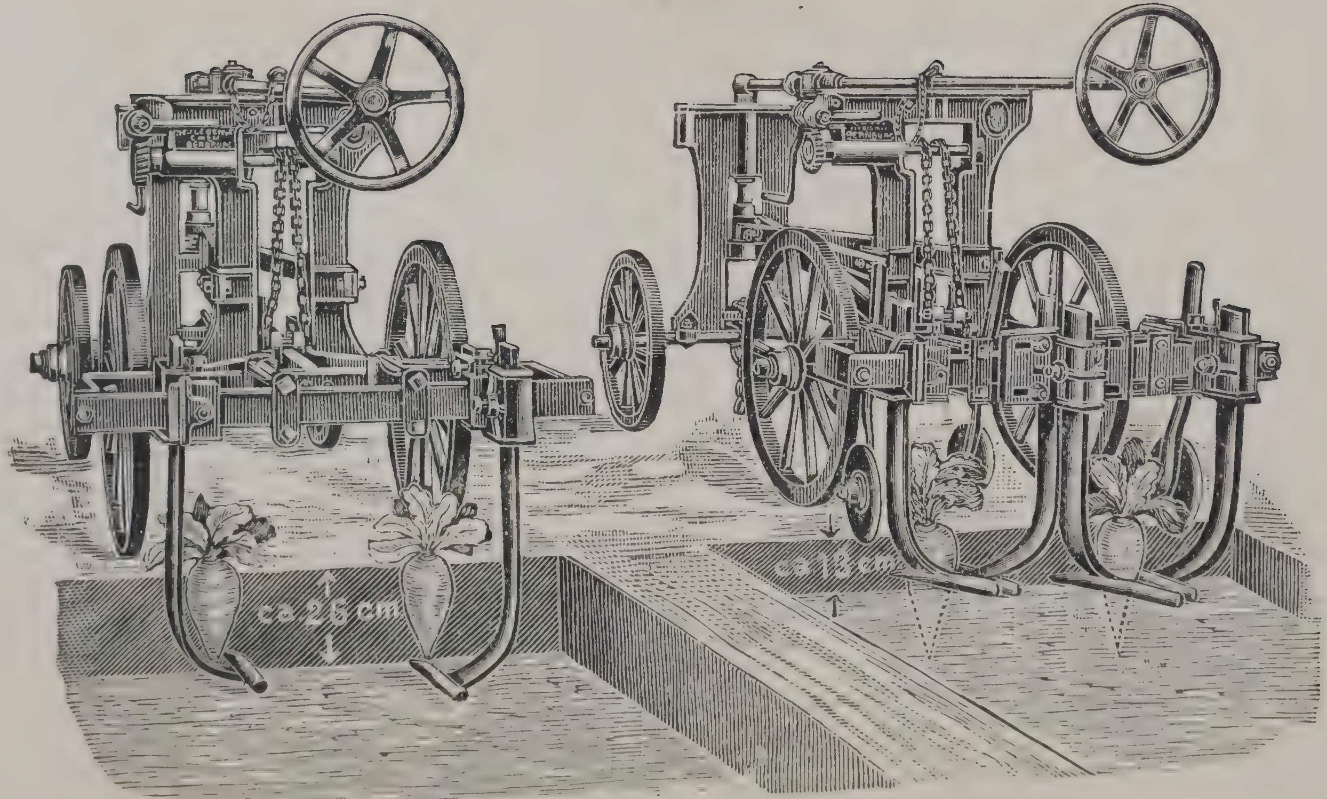
* "In Mecklenburg we were given the following figures as representing the cost price per acre, everything included: Beets, £12; potatoes, £11 5s.; corn, £6 8s."—French Report.



GERMAN BEET HARVESTER WORKING WITH TWO AND FOUR SHARES

This is the harvester shown on page 358. For dry ground two shares are fitted ; for soft ground, four. The two depths indicated are, it will be seen, about 10in. and 5in.

production is £9 per acre, exclusive of rent, and the price obtained not less than £1, and generally about 23*s*., per ton, it will be seen that there is ample margin for profit. The actual cash profit is supplemented by the return of the slices at a moderate price, the value of the leaves (which may be safely considered at £1 per acre), and last, but not least, by the increased fertility and cleanliness of the land.

In Germany, the general opinion is that a distinct and appreciable profit is obtained; but opinions differ somewhat. In one place I was informed that beet was the best paying crop of the rotation. At another farm I was told that they did not look for much profit, but they relied on their beet tillage to give them better yields all through the rotation. Of course, profits would vary according to the land, farmer, and general conditions.

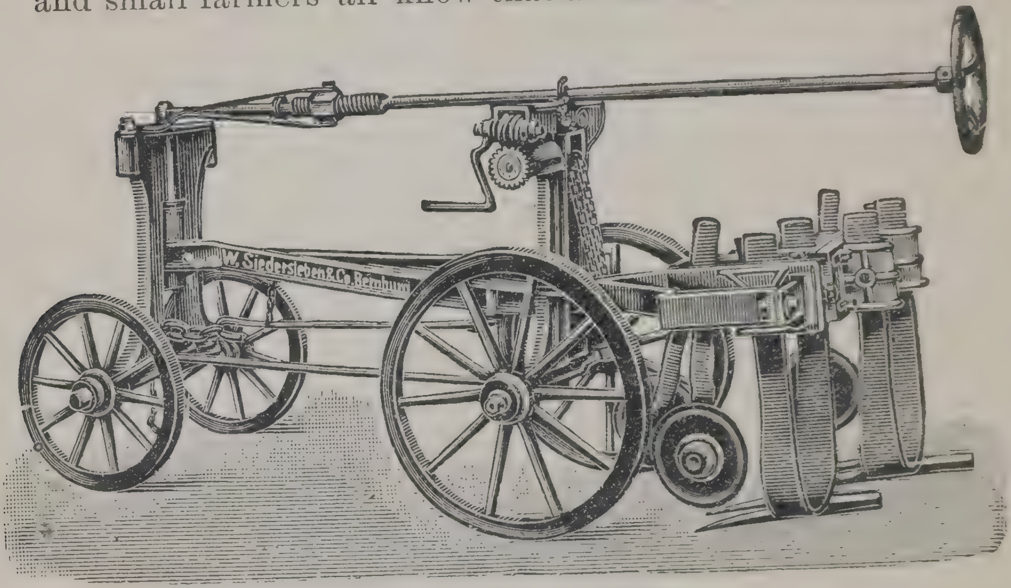
A yield of eleven tons per acre at £1 a ton should, under ordinary conditions, well repay any farmer for growing, because he has substituted for turnips and swedes, whereby he loses money, a crop that gives him a cash return which, at the very least, pays for all his out-of pocket expenses; and the land has been thoroughly and deeply tilled. Most of the large farmers are shareholders in the factories.

Advantage of Beet Culture.—I was told, both in Germany and France, that increased fertility of the soil followed in the wake of beet culture. It was difficult to obtain figures to prove this, owing to the fact that beet culture has been such a recognised thing for so many years; but the following figures of results of experiments carried out by M. Dumont, Professor of Agriculture at Cambrai, France, go to prove this statement:

Yields Per Acre.

Period.	Beet.	Wheat.	Oats.
1899-1901	11·7 tons	4·3 qrs.	7 qrs.
1907-1909	14·1 tons	4·7 qrs.	8 qrs.

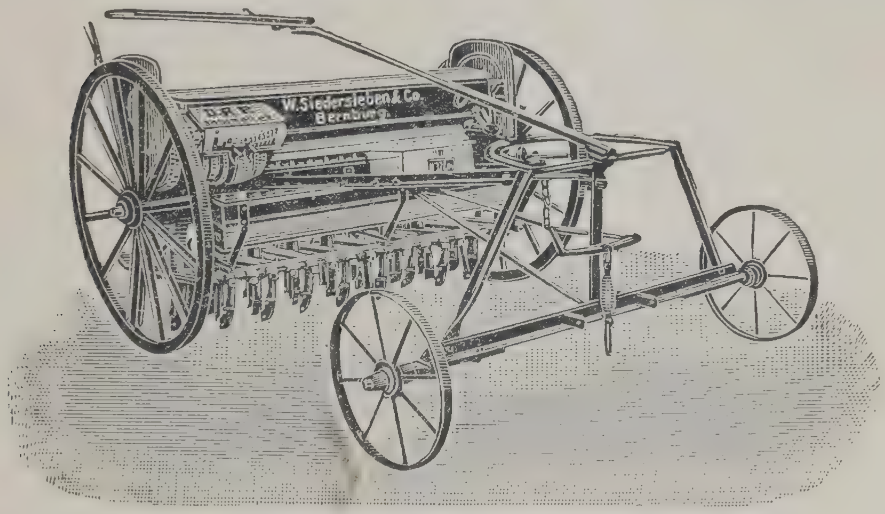
Why should not the English farmer cultivate his present roots as well as beet is cultivated? The answer is simple, but of extreme importance. On the Continent, the large and small farmers all know that at the end of the season their beet will be sold for hard cash. There is no wondering how the market will be for sheep when they are sold after feeding off the roots. It is argued that mangels can be grown on land that is not clean, and where beet would suffer badly. This really means that the farmer is induced to clean his land better with beet than with his present roots. Any one who visits the beet farms in Germany cannot help being struck by the extraordinary state of cleanliness of the land for mile after mile.



A German Beet Harvester
End view on page 372

General Remarks.—Many of the factories are surrounded by their own land. This system commends itself as being very practical. The farms are fitted up with light railways, so that the roots can be rapidly taken to the factory, and the slices returned and stored as desired. Bullocks are largely used in both France and Germany for draft purposes.* Perhaps the last has not been heard of them in our own country. They are large, strong animals, worth about £35. Slices form a large proportion of the food of these animals, who help to make dung for the farm, and, finally, in about seven years, are sold to the butcher.

Sheep.—Large numbers of sheep are kept on certain farms in France and in Germany, but they spend most of the year under cover in large barns. There should be no necessity for such practice in this country. It would be quite simple to trough-feed the sheep on the land, although in many ways the French system seems to offer certain advantages during the winter months. The great value of treading and manuring the land by sheep would seem to be compensated for by the following: (*a*) the highly concentrated manure is carted and evenly spread; (*b*) the deep tillage would seem to avoid the "hover" or open



A GERMAN SEEDING MACHINE

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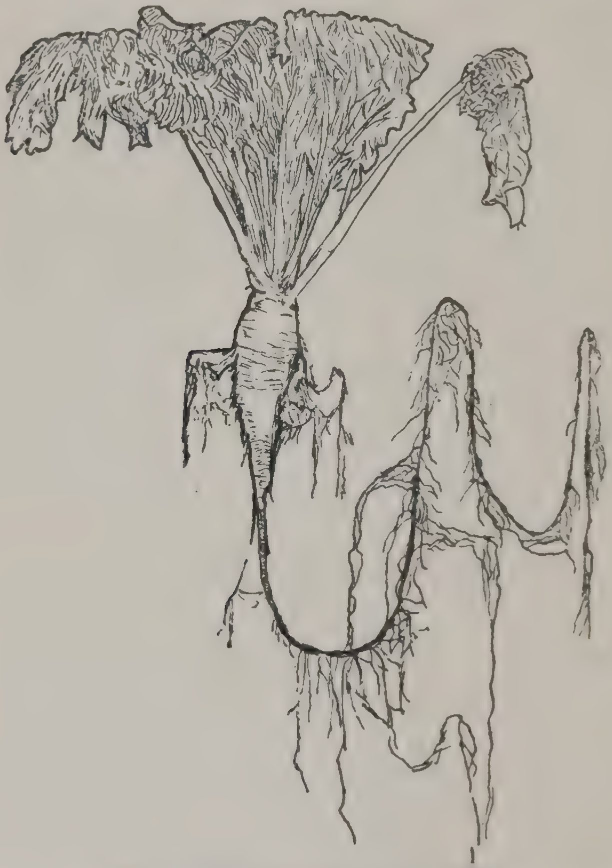
* Steam ploughing, which is often resorted to in the cultivation of beet, and narrow-gauge railways which are found on many farms, decrease the number of draft animals required. Sometimes farmers club together to construct a railway.—FRENCH REPORT.

condition and root falling that we get on some soils that are always ploughed to a uniform shallow depth; (*c*) a considerable amount of rolling is resorted to.

In the beet areas of France one meets with very little of grass land, and in Germany the acreage is comparatively small and often inferior.

It is obvious that any factory starting in this country will not be able to pay the high rate of 23s. per ton to start with. Expenses will be heavy at first, and the factories must of necessity leave a margin in order to be able to pay the farmers a higher price as time goes on.



THE DEEP-ROOTING SUGAR BEET

Drawn from "La Betterave à Sucre." Percival's "Agricultural Botany" speaks of "drains 4ft. and 5ft. below the surface" blocked by mangel roots.

APPENDIX

BOARD OF AGRICULTURE EXPERIMENTS, 1911

THE following notes are taken from the half a dozen typed sheets of instructions sent by the Board of Agriculture to the agricultural colleges experimenting with sugar beet in 1911 :

SOWING.—Experimenters should sow at double or treble the "corn" width of the district if corn is drilled at not less than 7in. ; but if less than 7in. then the beet should go at three and four times the width of the corn. Beet does well at 14in. apart if horse-hoes are available for working between such narrow rows. The best distance for sowing on the flat will probably be from 18in. to 21in. It is not likely that the best results will be got from rows as much as 24in. apart. Where the coulters of the seed drill are readily adjusted three widths of sowing should be tested, narrow rows, 14in.-16in. ; medium, 18in.-20in. ; and wide, 21in.-24in. apart.

SINGLING.—The beet should be left 9in. apart. On the Continent various distances from 8in. to 12in. are adopted. In England, where the average distance between the rows will be wider than on the Continent, not more than 9in. between plants would be desirable. With the ordinary English hoe it should be possible to work to 9in. apart with fair regularity if there is a good "plant."

QUANTITY OF SEED.—The German seed rate is very high, usually about 30lb. per acre for rows 16in. apart. This corresponds to 16lb. to 18lb. mangel seed at the width usually drilled in this country ; or about twice as much as would be required to secure a sufficient "plant" with the soil in good condition. Enough beet seed will be sent to furnish 20lb. per acre.

MANURING.—The artificial manures will be supplementary to farmyard manure (except in Essex). The standard manure, variations in the use of which will be experimented with, is : 20lb. nitrogen in sulphate of ammonia before or when sowing ; 10lb. nitrogen in nitrate of soda a week to ten days after singling ; 50lb. phosphoric acid in super-phosphate ; 30lb. potash in sulphate of potash.

TONS OF ROOTS AND SUGAR FROM THIRTY-FIVE VARIETIES OF SUGAR-BEET

The following averages are compiled from the result of six years' experiments (1903-9), made by Professor Remy, Institute of Soil Investigation and Plant Industry, Bonn University, on thirty-five different kinds of beet grown on eighteen different holdings. The roots of each variety were obtained in lots of 56lb. at the weighing-house of a well-known factory, and were, therefore, beets raised from ordinary commercial seed grown in the ordinary way by regular beet-growers, and delivered to the factory in the usual course.

Variety of Beetroot.	Average weight of roots per acre, tons.	Average yield of sugar per acre, tons.
Strube's Z.	10·21	1·80
Dippe's Z.	10·21	1·82
Mette's neuste zuckerreichste	11·52	1·84
Behren's Zuckkerrube	12·64	1·77
Orig. Kl. Wanzlebener E.	12·87	1·86
Orig. Kl. Wanzlebener Z.	12·88	1·85
Vilmorin's Elite A.	13·02	1·83
Schreiber's SO	13·22	1·96
Ziemann's (type B.)	13·42	1·92
Strube's E.	13·42	1·93
Rimpau's	13·57	1·90
Vilmorin's Elite B.	13·72	1·89
Heine's Improved Kl. Wanzlebener	13·73	1·98
Vorstadt's Original	14·11	1·97
Wohanka's WER	14·15	1·98
Dippe's Wl	14·22	2·08
Orig. Kl. Wanzlebener N.	14·35	2·07
Schreiber's SS	14·39	2·12
Dippe's Jl.	14·43	2·09
Ziemann's (type C)	14·43	1·99
Jaensch's SKS	14·54	2·11
Braune's impr. Kl. Wanzlebener	14·58	2·04
Jaensch's SVS	14·66	2·13
Meyer's Marke B	15·00	2·10
Strande's Zehringer Elite	15·04	2·06
Vorstadt's Swedish Zucht	15·08	2·05
Schreiber's SKW	15·24	2·20
Braune's Elite	15·24	2·18
Dippe's RR	15·39	2·22
Ziemann's (type A)	15·44	2·09
Wohanka's WZR	15·59	2·23
Meyer's Marke A	15·63	1·96
Strande's Zuckerreichste Elite	15·63	2·19
Vorstadt's Elite	16·09	2·08
Hoerning's Zuckkerrube	16·13	2·17

The tons are kilo tons = 2204lb.

VARIETIES USED IN BOARD OF AGRICULTURE EXPERIMENTS

Klein-Wanzleben Elite Heine, for main experiment.

Rabbethge and Giesecke Klein-Wanzleben Original, for variety test and thick and thin seeding.

Broune's Klein-Wanzleben Elite, Willy Mette's Klein-Wanzleben Ideal, Dippe Bros.' W.I., Breustedt's Elite, Aderstedter Original, Aderstedter (Geschalt und desinfiziert), Strubesche Zuckerrubensamen, for variety test.

MILLED SEED

Some of the seed sown in the Board of Agriculture experiments of 1911 was milled (*i.e.* peeled) and disinfected seed. The subject of milled seed is dealt with in a paper by Mr. L. Kühle, read at the Botanical Congress at Hamburg, in 1906. It is suggested that the naked seed is earlier and more economical in use. There is also a bacteriological problem. It is said that the treatment of the seed copes with Plasmodiophora brassica and Pythium. On the other hand, it is suggested that the disinfection cannot be wholly successful or advantageous. A scientific German farmer now in this country tells me "the improvement is not considered to be really worth the trouble," and Dr. Rabbethge writes from Klein-Wanzleben: "The question has not yet been decided and there are as many who speak in favour of milled seed as against it. We have not seen any advantage in using milled seed. By the milling process many germs are hurt, and the question as to the advantage of faster and better germination is not yet settled. We supply milled seed to everyone who wants it." The Wohanka seed breeding station expresses the opinion that "the investigations have mostly had negative results." See *Deutsche Zuckerindustrie*, June 9, 1911.

SUGAR BEET ORGANISATIONS

NATIONAL SUGAR BEET ASSOCIATION, LIMITED. Manager and Secretary, H. S. Alexander, 19, Abingdon-street, W.

BRITISH SUGAR BEET COUNCIL. Hon. Secretary, A. H. Matthews; Assistant-Secretary, W. T. Chadwin, 1 and 2, Orchard-street, Westminster.

Mr. Stein has started a Beet Sugar Pioneers' Council, at a meeting of which in July it was stated that schemes for factories at Kidderminster and in Cornwall and Cheshire would be pushed forward.

A NORFOLK CONTRACT

The following extracts are from Mr. Cohen's "Sale-Contract of Beetroots" for 1912 and the two following years:—

"If the seller delivers his beet free in railway truck or in lighter or wherry at the price of twenty shillings per ton net, he will be charged for any amount to be paid for freight to the Sugar Works or Central Depot in excess of 1/6 per ton.

"The beetroots shall be delivered regularly and successively between the Twenty-third day of September and the Fifteenth day of November of each year, but with consent of the buyers these dates may be altered.

"The beetroots must be cut off flat on the top where the lowest leaves are found, and be delivered in a condition as free from dirt or other foreign matter as possible.

"Any beetroots offered for delivery after the Fifteenth day of November, or special arranged date in each year, may be refused; also (*a*) all beetroots damaged by frost or water, by fungus, or being rotten or hollow; (*b*) all beetroots wholly or partially produced from seed other than that supplied by the buyers.

"An advance of £4 per acre may be obtained from the buyers by sellers approved of by them. The land under cultivation may be controlled by the buyers or their agents, and the seller shall be bound to permit the buyers or their agents on their land for this purpose. If required, the seller will require to give security for the advance to be made to him. The advance, being free of interest, must be settled before the .... day of .... of each contract year by delivery of beetroots in terms of this contract, and in the event of the seller's failure to implement this contract, the advance, or any balance thereof unpaid, must be repaid to the buyers on demand with interest thereon at the rate of 6 per cent. per annum from the date of advance. By non-payment the seller will be declared to be in default without the necessity of any summons or demand on the part of the buyers. If by controlling the land of the seller it is proven that considerably more land is contracted for than is brought under cultivation, any advance made must be repaid to the buyers for the full amount with interest at 6 per cent. per annum and a fine of £4 per acre.

"The seller binds himself not to sell or deliver beetroots cultivated from seeds other than that provided by the buyers, and in the event of the seller contravening this stipulation he binds himself to pay to the buyers a fine of £7 10s. per acre of land contracted for.

"The land contracted for must be prepared and ready to be sown with seed on the First day of April of each contract year.

"The net weight will be fixed by taking a sample of half a cwt. out of a lot of six tons, which sample will be cleaned. The difference to be ascertained by such cleaning will be considered as tare and calculated per ton. The average tare will be deducted over the whole lot offered for delivery.

"The seller undertakes and binds himself, by the loading or unloading the beetroots, to exercise the greatest care not to damage them in any way, and specially not to use any implements or means which would cut or injure them."

FOREIGN WEIGHTS AND MEASURES

The student of sugar beet literature must not forget the varying tons. In the United States the short ton of 2000lb. and the long or English ton of 2240lb. are both used. The Continental metric ton is 2204lb., or 19cwt. 2qrs. 20½lb. An English ton is 2031·86 German pounds. The German centner is a little less than a cwt., *i.e.*, 110·23117lb. An English ton is 22·40 centner. The morgen is a little more than half an acre, *i.e.* ·63 of an acre. Roughly, four morgen = 1 hectare = 2½ acres (2 acres 1 rood 35 perches exactly). Kilos may be transposed into pounds by being multiplied by 2¼, quintals into cwt. by being multiplied by 1¾, and tonnes into tons by being multiplied by 98 and divided by 100. Roughly, 1000 kilos are a ton.

THE POLARISCOPE

There is a full account of the polariscope by Mr. Martineau in his valuable handbook, "Sugar," in the course of which he says: "If light were made to pass through a properly adjusted crystal and were thus converted into a polarised ray, and if this ray were then intercepted by another similar crystal similarly adjusted, the polarised ray would pass freely through the second crystal. But if between the two crystals were inserted a tube containing a solution of sugar, the light would no longer pass through the second crystal, because the plane of the ray would have been deflected by the sugar. The second crystal would have to be turned until it arrived at the angle to which the ray had been deflected. When the light had fully reappeared, the angle through which the crystal had been turned would indicate the amount of deflection." The polariscope is, however, quite a complicated contrivance, and, in practice, the operator sees, "when the ray is not deflected, a field of uniform colour. But when the ray is deflected by the sugar he sees the field divided by a sharp, perpendicular line into two different colours. As he moves the compensator the colours become more uniform, and, when an absolute uniformity of colour has been restored, he reads off on the scale the percentage of sugar. This method gives great accuracy; but the instrument has now been superseded—perhaps in the interests of those who are colour blind—by one in which shadow is substituted for colour, which is said to be still more accurate." When sugar is rated 96 it means that there are in it 96 parts of sucrose and 4 parts of water and impurities.

DANGERS OF SACCHARINE

The United States Secretary of Agriculture in April, 1911, issued a decision, based upon a finding of the Referee Board of Consulting Scientific Experts, which forbad the use of saccharine in food after July 1. This affects more than 30 classes of food.

SEVEN YEARS' BEET ANALYSES, By H. METTE, Quedlinburg, Germany

Showing also proportionate weight of leaves and tops, rainfalls, temperatures, and sunshine

1910 analyses from average roots in 112 acres.	No. of beets analysed.	Weights of leaves with tops.	Weights washed beets.	Sugar in one root.		Density.	Brix.†	Sugar in the juice.	Not sugar.	Purity.‡	Rainfall.		Mean height barometer, mm.	Mean temp. daytime, Cent.	Hours of sunshine during week.
		Grams* per beet.		Soluble in cold water. Per cent.	Grams.						During week, mm.	Since April 1, mm.			
July 16 ...	160	341	105	9·9	10·4	6·1	14·1	10·12	3·98	71·77	10·8	210·4	749·0	17·0	16·2
,, 23 ...	160	404	146	10·8	15·8	6·2	14·8	11·43	3·37	77·23	15·7	226·1	746·4	17·1	29·8
,, 30 ...	160	357	172	12·9	22·2	6·7	16·8	13·53	3·27	80·54	4·2	230·3	747·5	16·4	31·1
Aug. 6 ...	160	444	220	13·4	29·5	6·6	16·5	13·69	2·81	82·97	38·2	268·5	747·1	18·8	18·7
,, 13 ...	160	539	252	13·9	35·1	7·1	17·7	14·79	2·91	83·56	31·5	300·0	748·2	16·5	37·2
,, 20 ...	160	400	279	15·5	43·3	7·7	19·3	16·38	2·92	84·87	6·2	306·2	752·0	17·5	41·4
,, 27 ...	160	463	332	15·9	52·8	7·8	19·3	16·44	2·86	85·18	15·3	321·5	749·8	16·6	29·8
Sept. 3 ...	160	451	381	16·3	62·1	8·2	20·2	17·38	2·82	86·04	18·2	339·7	751·9	15·9	23·7
,, 10 ...	160	423	396	16·6	65·7	8·1	20·1	17·40	2·70	86·57	11·0	350·7	750·2	12·8	20·7
,, 17 ...	160	399	418	16·9	70·6	8·3	20·5	17·85	2·65	87·07	32·2	382·9	752·5	13·5	28·9
,, 24 ...	160	384	447	17·1	76·4	8·3	20·6	18·01	2·50	87·86	18·8	401·7	756·0	11·9	26·0
Oct. 1 ...	160	366	455	18·0	81·9	8·8	21·7	19·07	2·63	87·88	0·3	402·0	755·5	12·5	27·1
,, 8 ...	160	380	513	18·4	94·4	9·0	21·9	19·36	2·54	88·40	5·2	407·2	756·7	12·9	24·1
,, 15 ...	160	340	520	18·8	97·8	9·2	22·6	20·19	2·41	89·34	0·7	407·8	752·6	12·0	15·6
Oct. 16 '09	3100	280	440	17·50	77·00	8·50	20·9	18·32	2·58	87·66	22·4	367·2	753	12·1	14·0
,, 17 '08	160	234	460	20·9	96·1	10·40	25·3	21·69	3·56	85·91	—	303·3	758	13·1	57
,, 19 '07	150	234	483	19·4	93·7	—	—	—	—	—	-3·	343·4	745	13·4	—
,, 20 '06	160	226	458	18·2	83·4	—	—	—	—	—	—	–418·	749	11·2	—
,, 14 '05	150	300	469	18·7	89·6	—	—	—	—	—	18·2	411·3	752	6·1	—
,, 15 '04	—	—	—	—	—	—	—	—	—	—	–3·	267·8	754	5·8	—
,, 17 '03	150	247	423	18·1	78·2	—	—	—	—	—	5·8	378·5	743	11·1	—

* Grams.—100 grams = 3½oz. † Brix hydrometer professes to give total solids in solution. ‡ PURITY QUOTIENT.—As a rule, the larger the proportion of non-sugars present, the smaller the quantity of sugar that can be separated. The purity quotient is the quantity of sugar per 100 of dry substance.

LICHT'S TESTS OF WEIGHTS AND RICHNESS OF SUGAR BEETS IN GERMANY

Magdeburg district.			In Principal Beet-growing Districts.								
1910.			1910.			1909.			1908.		
Date.	Weight.	Sugar.	Date.	Weight.	Sugar.	Date.	Weight.	Sugar.	Date.	Weight.	Sugar.
		per cent			per cent			per cent			per cent
Jun. 17	13 gr.	6·24									
,, 24	35 ,,	7·46									
July 1	62 ,,	8·38				Jul. 2	14 gr.	8·30	Jul. 3	36 gr.	9·74
,, 8	91 ,,	9·16	July 8	64 gr.	9·34	,, 9	31 ,,	7·99	,, 10	55 ,,	10·55
,, 15	123 ,,	9·79	,, 15	88 ,,	9·92	,, 16	53 ,,	8·39	,, 17	88 ,,	11·85
,, 22	170 ,,	10·74	,, 22	131 ,,	11·58	,, 23	82 ,,	9·80	,, 24	127 ,,	12·05
,, 29	222 ,,	11·81	,, 29	165 ,,	12·39	,, 30	124 ,,	11·63	,, 31	169 ,,	12·35
Aug. 5	284 ,,	12·94	Aug. 5	218 ,,	13·94	Aug. 6	170 ,,	12·27	Aug. 7	210 ,,	13·56
,, 12	326 ,,	13·02	,, 12	261 ,,	14·06	,, 13	221 ,,	13·47	,, 14	259 ,,	15·02
,, 19	368 ,,	13·91	,, 19	296 ,,	14·86	,, 20	239 ,,	15·11	,, 21	288 ,,	16·13
,, 26	409 ,,	14·93	,, 26	339 ,,	15·53	,, 27	283 ,,	15·59	,, 28	326 ,,	16·55
Sept. 2	451 ,,	15·79	Sep. 2	376 ,,	16·31	Sep. 3	312 ,,	16·78	Sep. 4	379 ,,	16·90
,, 9	486 ,,	15·91	,, 9	405 ,,	16·31	,, 10	328 ,,	17·89	,, 11	384 ,,	17·66
,, 16	522 ,,	15·97	,, 16	441 ,,	16·54	,, 17	359 ,,	18·33	,, 18	409 ,,	18·47
,, 23	561 ,,	16·84	,, 23	476 ,,	17·28	,, 24	393 ,,	17·50	,, 25	422 ,,	19·25
,, 30	599 ,,	17·93				Oct. 1	429 ,,	17·82			
Oct. 7	640 ,,	18·79									

[From the *Daily Commercial Report*, Bagot and Thompson, 21, Cullum-street, Fenchurch-street, E.C.]

KLEIN-WANZLEBEN FIGURES FOR WEIGHTS OF LEAVES AND TOPS AND ROOTS IN 1910, IN GRAMS

Date.	Leaves and top and root.	Leaves and top.	Root.
Aug. 12 ...	631	383	248
,, 19 ...	636	364	272
Sept. 2 ...	713	373	340
,, 9 ...	734	358	376
,, 16 ...	785	368	417
,, 23 ...	820	368	452
,, 30 ...	809	351	458

CROPS OF OUR NEAREST NEIGHBOURS

THREE-YEAR PERIODS

Country.	Tons of beet per acre.		Sugar per cent. of roots.		Tons of sugar per acre.	
	1899–1902	1905–8	1899-1902	1905–8	1899–1902	1905–8
Germany......	11·77	12·07	14·78	16·13	1·73	1·95
Holland	10·71	10·98	13·94	13·23	1·18	1·62
Belgium	12·92	11·87	13·24	14·71	1·70	1·75
France.........	11·54	11·13	12·51	13·23	1·45	1·47

THE LAST THREE YEARS

The following figures are from a report by United States Consul-General, H. W. Diederich, at Antwerp, based on the returns at the end of 1910 by the factories' statistical bureau :

	Tons of Beet per acre.			Sugar per cent. of roots.			Tons of Sugar per acre.		
	1910.	1909.	1908.	1910.	1909.	1908.	1910.	1909.	1908.
Germany ...	13·3	11·4	10·9	16·5	15·7	17·7	2·20	1·79	1·93
Austria	11·2	10·2	9·7	15·4	15·4	17·6	1·76	1·57	1·71
France	9·3	11·3	11·2	13·3	12·8	13·6	1·29	1·44	1·52
Belgium......	12·1	10·9	12·0	14·4	14·1	15·2	1·73	1·55	1·82
Holland	11·8	9·5	11·2	15·2	14·9	15·8	1·79	1·41	1·78

NUMBER OF ACRES SOWN TO BEETS

	1910–11.	1909–10.	1908–09.
Germany	1,170,285	1,124,909	1,077,832
Austria	901,931	796,261	815,903
France	575,529	573,514	538,573
Russia	1,692,665	1,367,747	1,371,947
Belgium	164,076	159,628	140,972
Holland	122,563	139,613	119,721
Other countries	333,590	343,980	378,310
Totals	4,960,639	4,505,652	4,443,258

The International Association for Sugar Statistics data, collected between May 3 and 13, in 1911, indicate an aggregate acreage of 2,174,078 hectares in beets for Europe, which compares with 1,992,374 in 1910. The first half of the table, including Sweden, gives the official figures; the rest are unofficial. The figures are hectares:

	1910.	1911.	Change.
Germany	473,585	496,834	+ 4·9
Austro-Hungary	369,700	397,200	+ 7·4
France	228,700	225,400	– 1·4
Belgium	66,100	60,800	– 8·0
Holland	49,651	55,744	+ 12·3
Russia	667,400	787,000	+ 17·9
Sweden	35,250	27,300	– 22·6
Denmark	22,200	24,000	+ 8·1
Italy	41,200	60,000	+ 45·6
Spain	20,000	20,000	......
Roumania	13,318	12,000	– 9·9
Servia	2,970	5,300	+ 78·4
Bulgaria	1,700	1,700	......
Switzerland	600	800	+ 33·3
Total	1,992,374	2,174,078	+ 9·1

FRENCH AND DUTCH GOVERNMENT STATISTICS

Year.	France.	Holland.	Year.	France.	Holland.
1900 ...	329,810	46,493	1905 ...	271,930	47,046
1901 ...	338,800	49,441	1906 ...	221,047	42,381
1902 ...	252,590	33,212	1907 ...	201,000	44,144
1903 ...	240,450	39,692	1908 ...	222,970	47,753
1904 ...	202,920	34,310	1909 ...	236,780	55,062

There has since been a further fall in France, according to the statistics of the International Association. 1910, 228,700 hectares; 1911, 225,400 hectares. According to the same authority, the figures for Holland for 1910 were 49,651 hectares, and for 1911, 55,744 hectares.

Two Years' Production on the Continent

	Tons of Beets.		Tons of Sugar.		Increase or Decrease per cent.
	1909.	1910.	1909.	1910.	
Germany ...	12,892,100	15,556,000	2,637,397	2,502,400	+ 22·8
Austria Hungary	8,166,200	10,088,000	1.245,608	1,541,800	+ 23·8
France... ...	6,246,800	5,479,700	803,006	714,450	—11·0
Russia... ...	6,837,500	13,119,700	1,123,594	2,115,000	+ 88·2
Belgium ...	1,777,600	1.978 000	248,403	280.000	+ 12·7
Holland ...	1,330,000	1,445,600	194.822	214,700	+ 10·2
Sweden ...	897,000	1,098,000	127,000	171,060	+ 34·0
Denmark ...	500,000	746,000	65,000	109,000	+ 67·7
Italy	970.000	1,500,000	118,900	184.000	+ 54·7
Spain	667,000	490,000	83,000	60,000	—27·7
Switzerland ...	25,000	25,000	3,500	3,500	0
Roumania ...	208,000	275,000	30.775	38.000	+ 23·5
Servia	66,000	75,000	8,630	10,000	+ 15·9
Bulgaria ...	20,000	31,400	2,435	3,700	+ 51·9
Total	40,603,200	51,907,400	6,092,070	7,947,550	+ 30·5

"Russia will in all probability be the banner country in the future."
—Dr. A. von Wachtel, March 24, 1911.

Ten Years' Production in Germany (Martineau)

Year.	Acres.	Roots (Tons).	Roots per acre (Tons).	Sugar (Tons).	Yield of Sugar per 100 of roots.	Sugar per acre (Tons).
1899–00	1,070,355	12,466,000	11·64	1,791,250	14·37	1·67
1900– 1	1,119,015	13,252,000	11·84	1,974,800	14·90	1·76
1901– 2	1,196,872	16,000,000	13·38	2,293,300	14·33	1·92
1902– 3	1,069,110	11,256,000	10·54	1,750,600	15·53	1·63
1903– 4	1,042,192	12,706,000	12·16	1,929,410	15·22	1·85
1904– 5	1,037,005	10,071,000	*9·70	1,605,400	15·94	1·54
1905– 6	1,179,355	15,727,000	13·34	2,394,400	15·23	2 03
1906– 7	1,110,457	14,187,000	12·80	2,242,100	15·80	2·02
1907– 8	1,121,232	13.483,000	12·02	2,136,000	15·99	1·90
1908– 9	1,087,215	11,799,000	10·84	2,080,000	17·63	1·91
Average	...	...	11·87	...	15·49	1·83

* Drought.

THE GERMAN BEET SUGAR INDUSTRY

The United States Consul General in Berlin sends the following tables taken from official statistics of the beet sugar industry:

Year.	Acreage.	Beets worked up.	Average yield per acre.	Number of factories.	Raw sugar.	Molasses.
		Tons.	Tons.		Tons.	Tons.
1905-6 ...	1,165,695	15,733,478	13·5	376	2,314,779	328,752
1906-7 ...	1,104,465	14,186,536	12·8	369	2,124,326	320,787
1907-8 ...	1,112,044	13,482,750	12·1	365	2,017,071	287,266
1908-9 ...	1,077,832	11,809,182	10·9	358	1,980,387	275,395
1909-10...	...	12,904,795	...	...	1,940,911	271,104

During 1908-9 there were also 39 sugar refineries that made a speciality of refining raw sugar and converting it into granulated, crystallised, lump, loaf, and the numerous other forms in which sugar is handled in the sugar trade. There were also 6 plants that made a speciality of the extraction of sugar from molasses, or beet syrup, and converting it into trade sugar. The number of molasses extracting factories has remained the same during the last ten years, while the number of sugar refineries and sugar factories in Germany shows a gradual decrease. The average volume of sugar beets worked up and the quantities of unrefined and the trade sugars obtained has, however, increased.

Besides the quantities of sugar beets given in the foregoing table, the following quantities of (1) raw unrefined sugar, (2) molasses or beet syrup, and (3) refined sugar which was added in the refining and extracting processes, were also worked up in the sugar factories and refineries and molasses extracting plants:

Year.	Raw sugar.	Molasses.	Refined sugar.
	Tons.	Tons.	Tons.
1905-6	1,602,350	222,670	23,407
1906-7	1,518,419	246,500	25,154
1907-8	1,416,380	240,673	28,117
1908-9	1,474,193	213,591	24,176
1909-10	1,472,178	184,868	24,966

The net quantities of raw and refined sugar of commerce obtained in all German beet sugar factories, sugar refineries, and molasses extracting plants, as well as the net raw sugar equivalent of 10 to 9 were as follows:

Year.	Raw sugar.	Refined sugar.	Raw sugar equivalents.
	Tons.	Tons.	Tons.
1905-6	2,127,948	1,711,063	2,400,771
1906-7	1,949,099	1,655,383	2,242,046
1907-8	1,846,670	1,565,713	2,138,731
1908-9	1,825,730	1,579,091	2,079,221
1909-10	1,792,457	1,561,260	2,027,273

During the report year 1909-10 the quantity of raw and refined sugar worked up by (1) the beet sugar factories, (2) the sugar refineries, (3) the molasses extracting plants, and the quantity of raw and refined sugar of all kinds obtained were as follows:

	Worked up.		Obtained.	
	Raw.	Refined.	Raw.	Refined.
	Tons.	Tons.	Tons.	Tons.
Beet sugar factories ...	272,803	15,126	1,786.549	399,575
Sugar refineries ...	1,100,193	6,698	2,376	1,001,656
Plants extracting sugar from molasses ...	99,182	3,142	3,532	160,029

EXTRACTS FROM GERMAN SUGAR FACTORIES

The following extracts are from the accounts of a German sugar factory for 1909-10, the report of which is before me. The directors say:

"In giving the following account of the 26th year of our business we would say that if we may look back on the yield of this year with satisfaction, we owe it chiefly to the fact that the price of sugar at the beginning of the campaign rose steadily. In the spring of 1910 it reached 15s., a figure higher than has been experienced for some years. In spite of the fact that we disposed of part of our products at a lower price, the result may be considered as favourable.

"The root harvest was a good one as far as the quality of the roots was concerned. It compared favourably with that of former years, and also with regard to the actual yield of sugar. 71.049·884 tons were delivered from 5.161·59 acres. This makes a yield of about 13·8 tons to the acre, compared with 14·45 tons last year, and 13·1 tons two years ago."

The accounts show, with the profit of £5.861 carried forward from the years 1908-09, a gross profit of £38,109. For depreciation we have written off £4244, leaving £33,865 for disposal in the following manner:

5 per cent. to general reserve fund of £28,003 ...	£1,400
4 per cent. dividend on £75,000	3,000
Contribution to the retirement fund for officials ...	600
Contribution to the retirement fund for workmen...	600
To factory hospital	100
Directors' fees, &c.	4,888
New buildings and machinery	6,500
13 per cent. super dividend	9,750
Carried forward to new account... ...	7,026
	£33,865

The campaign was opened on October 18, 1909, and closed on January 5, 1910. The 71,049·884 tons of roots delivered from 4185 farmers were dealt with in 144 divisions, *i.e.*, 72 days' work. There was handled, therefore, in every day's work an average of 986·765 tons of roots, compared with 814·283 tons last year. For the coming campaign we have made contracts for a sufficient number of acres of roots at a price a little more than ½d. per cwt. higher than last year's.

The report bears the signatures of the two managers. The directors number seven.

The following particulars from German sugar factories' balance sheets appeared in the *Deutsche Zücker Industrie* in May, 1911:

The figures of the Weferlingen factory are: Expenditure—Own roots, £79,221; bought roots, £14,021; current expenses, £18,028. Receipts—Sugar, £113,020; molasses, £5066. First product sold for 9s. 8¾d. per cwt.; second product for 8s. 2½d. per cwt., and molasses for 2s. 2½d. per cwt.

The factory at Nauen, the capital of which is stated at £80,000, made a net gain of £15,582, and paid a dividend of 15 per cent.

The Demmin factory used, in a campaign lasting from September 22 to December 7, 56,678·01 tons of roots, or 801·04 tons per double shift. The average sugar content of roots was 16·3 per cent., as against 15·3 in the preceding year.

The Soest factory paid a 10 per cent. dividend, and has done so for two years past.

The Friedländer factory states that "the large previous selling of sugar was of great assistance, for a great drop in price set in just at the beginning of the campaign, so that for a considerable period no more than 8s. 5½d. per cwt. was obtainable."

The following are comparative figures :

	Roots handled in campaign.	Roots handled per day.	Crop per acre.	Sugar in slices.
1909-10 ...	55,540 tons ...	921 tons ...	10·7 tons ...	15·87 per cent.
1910-11 ...	76,063 ,, ...	966 ,, ...	13·65 ,, ...	16·53 ,,

By April two-thirds of the molasses had been turned into cattle food ; the remaining third would be similarly treated in May and June.

KLEIN-WANZLEBEN

In the introduction to the accounts of the famous Klein-Wanzleben Company, the directors say : The campaign lasted from October 5 to December 9, 1909, 1,058·31 tons of beets being worked on an average per day. Total 63,530·553 tons of beets, out of which were made 10,650·2101 tons of sugar and 141·135 tons of molasses. Some 2241·924 tons of dried slices were also produced.

The following new works had been carried out : Enlargement of the slicing room through the setting up of a new slicing machine ; a slices transporter ; and a water purifier.

The lack of sunshine in the summer and autumn of 1909 resulted in a beet harvest generally small in quantity. Moreover, the sugar crop was less than that of the preceding year. The total sugar harvest of Europe fell so low that the prices for sugar rose and kept at a height which has not been known for many years. The financial return of the factory work was, therefore, in spite of the small amount of sugar, a good one. The harvests of the farms were very good. On the whole, the returns were the highest since the beginning of the company. Also the beet harvest of our own farms was comparatively better than elsewhere on the whole in Germany. The prices for all products were, moreover, higher than normal, so that the financial return is a very satisfactory one. Carriage, by means of our field railway, is satisfactory.

The report adds that the live stock numbers 191 horses, 505 oxen, 64 bulls, and 11,347 sheep.

As Klein-Wanzleben is a seed-growing establishment as well as a sugar factory, the accounts would be of no particular interest in full.

A 12 per cent. dividend was declared. The gross gain was £87,180 17s. 9d. There was £7426 1s. 11½d. brought forward, leaving £79,754 14s. 9¾d. The apportionment was :

	£	s.	d.		£	s.	d.
Reserve	6,364	11	8	7 per cent. Super Dividend ...	15,764	11	8
Buildings ...	4,357	5	10	7 per cent. Extra Reserve... ...	15,764	11	8
Railway	1,321	17	6	Carried Forward ...	5,787	13	2
Extra Reserve ...	10,575	0	0		£87,180	17	9
Pensions, &c. ...	9,791	13	4				
Directors... ...	1,210	9	10¾				
Managers ...	4,982	14	8¼				
5 p'cent. Dividend	11,260	8	4				

WORKING EXPENSES PER TON OF ROOTS, &c.—KRUSCHWITZ.

As the figures of the Kruschwitz factory, reproduced by Mr. Martineau in his manual, "Sugar," have been used as the basis of so much discussion, it may be useful to add them. This factory has been running nineteen years, but was modernised four or five years ago. Mr. Martineau's figures are for 1908-9:

Roots worked, 135,959 tons; average polarisation, 17·10. Price of roots, 21s. per ton.

	Shillings.
Coal	1·38
Materials	·53
Lime	·56
General expenses	·264
Repairs	·58
Wages	2·196
Insurance of workmen	·176
Contributions	·41
Insurance	·092
Total	6·188
Roots	21·136
	27·32
Depreciation	1·07
Total cost per ton of roots	28·39 shillings.

Six tons of roots produced one ton of sugar. The cost per ton of roots being 28·39 shillings, the cost per ton of sugar is 170·34 shillings, or £8 10s., or 8s. 6d. per cwt.

SUGAR PRODUCED.

	Tons.
First products (average analysis 90·25) ...	20,818
Second products (average analysis 81·52) ...	1,805
Molasses	1,806

YIELD PER CENT. OF ROOTS.

First products	15·31
Second products	1·33
Total	16·64 per cent.
Molasses	1·33 per cent.

AVERAGE PRICES

First products, 10s. per cwt., basis 88 f.o.b.
Second products, 8s. 6d. per cwt., basis 75 f.o.b.

As first products analysed 90·25 and secod 81·52, they fetched more than 10s. and 8s. 6d. Hence the average price for the whole output came to 10s. 6d.

	s.	d.	
Receipts for sugar ...	10	6	per cwt.
Expenses	8	6	,,
Profit	2	0	,,

Profits, £45,076, equal to 29 per cent. on capital.

Dividend of 22 per cent. paid after payments to reserves and bonuses. Of the rest £8669 was paid to the growers on account of the good year and the short weight but good quality of the roots. Dried pulp (2603 tons) consumed 1482 tons of coal, and fetched £8335 net, after deducting expenses of drying. The high yield of 16 to 17 per cent. of sugar from the roots made the season a very profitable one to the factories.

SIXTEEN GERMAN FACTORIES

The following figures as to the working of German factories in the prosperous 1908-09 year were given by Dr. Schack-Sommer in his "Sugar in Field and in Factory," 1910, and were, he tells me, from the *Deutsche Zuckerindustrie*.

Name of Factories.	Share Capital. Mk.	Quantity of Beets worked up. Centners.	Price of Beets per ton. Pfg.	Written off. Mk.	Profits. Mk.	Loss.	Dividends. per cnt
Friedland ...	500,000	988,900	114	78,615	125,000	—	25
Osterwieck ...	415,700	413,720	110	17,952	116,149	—	27
Wendessen ...	384,000			12,711	123,067	—	32
Coethen ...	205,500	502,000	114·6	3,700	111,961	—	54
Anklam ...	1,000,000	2,409,125	124·6	140,000	280,027	—	27
Strehlen ...	571,500	1,166,560	115	61,300	412,259	—	70
Twulpstedt ...	400,000			23,398	144,374	—	36
Kosten... ...	907,500			63,210	420,745	—	45
Culmsee ...	1,300,000	3,118,880	121·9	335,203	260,000	—	20
Tuczmow ...	1,000,000	1,360,360	116	65,213	446,762	—	44
Broitzem ...	220,500			11 404	42,865	—	19
Hessen ...	406,500	718,000	113	24,964	134,761	—	33
Kruschwitz ...	2,484,000	2,719,180	105·7	147,041	901,542	—	36

Name of Factories.	Share Capital. Mk.	Quantity of Beets worked up. Centners.	Price of Beets per ton. Pfg.	Written off. Mk.	Profits. Mk.	Loss.	Dividends. per cnt.
Amsee	1,000,000			77,632	409,890	—	30
Broistedt ...	412,500	815,960	103	48,393 (57,102 old debt.)	102,234	—	24
Schroda ...	1,000,000	1,469,970	115	71,733	495,364	—	49
Average (converted)	£38,180*	71,280tons	22s.	£3,873	£14,209	—	35

THE DECREASE IN THE NUMBER OF FACTORIES

Year.	Germany.	France.	Belgium.	Holland.
1900-1	395	334	107	32
1904-5	374	275	90	26
1909-10	356	245	79	27

The decrease is owing to more work being done in each factory.

COSTS IN AMERICAN FACTORIES

The following figures (converted into English money, reckoning a dollar as 4s. 2d.) Dr. Jodidi, in his "Sugar Beet and Beet Sugar" (1911), considers to be "an approximate statement for a factory of 600 tons daily capacity, 50,000 tons during 85 days."

	£	s.	d.
85 days × 200 people (including unloading and siloing beets) × 8s. 4d. a shift	7,083	6	8
Coal (18%) = 50,000 × $\frac{18}{100}$ × 11s. 5½d.	5,156	4	0
Salaries of permanent employées per year	3,750	0	0
Workmen outside of campaign: 10 people × 6 months × 25 days × 7s. 3½d.	546	17	6
Amortisation (including interests) of capital: 450,000 × 4%	3,750	0	0
Sugar bags and barrels (including packing) about ...	4,166	13	4
Repairing of machinery, apparatus, &c.	1,666	13	4
Lime rock, coke, oil, filter cloth, light, &c.	4,166	13	4
Taxes, insurance, and general expenses	4,166	13	4
Total	£34,353	1	6

Hence, according to this calculation, it costs

$\frac{£34,353\ 1\ 6}{50,000}$ or very nearly 13s. 9d. to convert one ton of beets.

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* Explained by the co-operative character of many companies, and working on loan capital which does not appear. The small capital of our own agricultural co-operative trading societies is well known.

The expenses in a small factory are comparatively greater than in a large one, and conditions naturally change with location and special circumstances.

PRODUCTION OF BEET SUGAR IN THE UNITED STATES

(In tons of 2000 pounds.)

Year.	Sugar.	Year.	Sugar.	Year.	Sugar.
1897	45,246	1902		1907	462,622
1898	36,368	1903	240,604	1908	425,884*
1899	81,729	1904	242,113	1909	512.468†
1900	86,082	1905	312,921	1910	511,866‡
1901	184,606	1906	483,612		

It was expected (says the *American Sugar Industry and Beet Sugar Gazette* of January, 1911) that renewed interest in the beet sugar industry would follow the passage of the tariff bill in 1908.

Although two new factories were added to the list in 1910, seven that had been in operation in former years were closed down owing to a lack of beets or other troubles. There were 61 factories in operation during the 1910-11 campaign against 64 in 1909, and 63 in 1908, 1907, and 1906. Five factories are being built.

This does not seem particularly rapid progress when all that is done is being done behind a tariff wall of 7s. per cwt.

CROP, FACTORIES, AND PRODUCTION IN 1910–11

States.	Factories.	Acres.	Actual yield of Sugar. Tons 2240 lb.
Michigan	17	117,700	116,315
Wisconsin	4	20,000	16,786
Ohio	2	13,000	9,902
Nebraska	2	13,028	7,082
Colorado	14	83,783	92.180
Utah	5	27,000	34.389
Idaho	3	17,500	12.740
California	8	97,493	129.950
Eight States	8	39,600	35.876
	63	429,014	455.220

"It is interesting and instructive to see that in the United States they can with difficulty produce more than 1 ton of sugar to the acre. In 13 States they produce *less*." So writes Mr. Martineau, who has kindly sent me this table.

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* From 3,414,891 tons of beet.

† From 4,081,382 tons of beet.

‡ Estimate. U.S. Government Estimate, 512,000 : value about 51,000,000 dols.

CANADIAN STATISTICS

	Factories.	1910-11. Tons Sugar.	1909-10. Tons Sugar.
Ontario	2	7,235	7,232
Alberta	1	536	1,570
Total Canada		7,771	8,802

TONS OF BEET REQUIRED TO PRODUCE 1 TON OF SUGAR (RAW PRODUCT)

	Tons.		Tons.
1871–1880	11·61	1890–1900	7·73
1880–1890	9·24	1900–1907	6·67

—Dr. Diedrich Meyer, Hackfruchtbau.

SUGAR PRICES

The Fall in Two Centuries

The following figures, though in American cents, are sufficient to illustrate the point at which the table aims. It is drawn up by Dr. A. von Wachtel, and is reproduced from the *American Sugar Industry :*

Year.	Price, Cents.	Year.	Price, Cents.
1700-1710	32·24	1810	11·77
1720	29·76	1820	8·66
1730	—	1830	5·87
1740	14·91	1840	11·79
1750	10·92	1850	6·25
1760	19·40	1860	6·80
1770	—	1870	5·35
1780	20·96	1880	4·42
1790	13·44	1890	3·69
1800	18·34	1900	3·16

These prices, however, are not quite comparable with those of the present time, as the money value was higher and the quality of sugar lower. The fluctation of sugar prices is now often enormous, as may be judged from recent London quotations, and is due to three factors : (1) crop results ; (2) constantly increasing consumption ; (3) constantly increasing production in the world. Generally speaking, the cheaper the sugar the greater the consumption. The northern people consume more sugar than those in southern climes, richer nations more than poorer, and in prosperous business years the consumption increases, and decreases in bad years. The *per capita* consumption increases constantly in all countries of the world.

PRICES OF SUGAR DURING 1910 AND 1911

1910.	s.	d.	1910.	s.	d.	1911.	s.	d.
January ...	12	10½	July ...	14	9¾	January ...	8	11¾
February ...	13	3	August ...	14	4½	February ...	9	5½
March ...	14	6	September	12	1½	March ...	10	3½
April ...	14	5	October ...	9	4	April ...	10	7¾
May ...	14	10	November...	9	0	June ...	12	0
June ...	14	6½	December...	9	0	July ...	13	0

AVERAGES, 1884–1910*

Average price per cwt. of 88 per cent. Beetroot Sugar f.o.b. Hamburg (Schack-Sommer)

	s.	d.		s.	d.		s.	d.		s.	d.
1884—	14	0	1891—	13	6	1898—	8	10¼	1905—	11	2†
1885—	14	0¼	1892—	13	7½	1899—	9	5¾	1906—	8	7¾
1886—	12	1	1893—	15	5¼	1900—	10	5	1907—	9	5¾
1887—	11	9	1894—	11	6¾	1901—	8	6½	1908—	10	5¾
1888—	14	0	1895—	9	10½	1902—	6	7½	1909—	10	11¼
1889—	16	10	1896—	10	6	1903—	8	3¾	1910—	12	9‡
1890—	12	6¾	1897—	10	6	1904—	10	0¾†	1911—		—

WORLD'S SUGAR PRODUCTION

1896–7 TO 1905–6

Year.	Beet.		Cane.	Total Tons.
	Europe.	U.S.		
1896–7	4,916,496	37,536	2.872,954	7,826.986
1897–8	4,831,774	40,399	2,864,255	7,736,428
1898 9	4,982,101	32,471	3,095.450	8.110.022
1899 0	5,518,048	72,944	3,030.303	8,621.295
1900–1	5,990,080	76,859	3,650,416	9,717,355
1901–2	6,750,478	163,126	4,079,742	10,993,346
1902–3	5,561,257	195,463	4,180.035	9.936,755
1903-4	5,881,333	208,135	4.234,203	10,323.631
1904-5	4,708,758	209,722	4.594.473	9.512,953
1905–6	6,933,649	283,717	4,919,716	12,137,082

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* These figures are not of course the price of raw sugar in England, where it has to bear the cost of duty, freight, and shipping charges.

† Drought.

‡ Speculation on short crop in Cuba upset by big crop in Europe, hence sudden fall from 14s. to 9s.

1905–6 to 1909–10

	1905 6.	1906–7.	1907–8.	1908–9.	1909–10.	1910–11.
Cane.						
United States:	Tons.	Tons	Tons.	Tons,	Tons.	Tons.
Louisiana and Texas	348,752	243,000	352,000	370,000	335,000	311,000
Hawaii	383,225	392,871	465,288	477,817	490,000	485,000
Porto Rico	213,000	210,000	200,000	245,000	280,000	293,000
Total United States	944,977	845,871	1,017,288	1,092,817	1,105,000	1,089,000
Cuba	1,178,749	1,427,673	961,958	1,513,582	1,700.000	1,600,000
Other West Indies	302,163	275,257	255,639	256,061	316,000	314,000
Mexico	107,529	119,496	123,285	125,000	130,000	150,000
Central America	18,516	19,747	19,258	21,000	21,000	21.000
South America	700,001	628,777	540,518	694,655	684,000	716,000
Total America	3,251,935	3,316,821	2,917,946	3,703,115	3,956,000	3,890,000
Asia	2,926,209	3,443,794	3,421,827	3,353,685	3,260.000	3,712,000
Africa	317,967	326,825	284,870	318,992	395,000	357,000
Oceania	230,000	249,000	280,725	231,098	217,328	291,000
Europe (Spain)*	15,722	16,400	11,000	20,000	16,000	24,000
Total cane-sugar production	6,741,833	7,352,840	6,916,368	7,626,890	7,844,328	8,274,000
Beet.						
United States	279,393	431,796	413,954	380,254	457,562	445,000
Canada (3 factories)	11,419	11,367	7,943	6,964	8,802	7,711
Total America	290,812	443,163	421,897	387,218	466,364	452,711
Total Europe	6,932,343	6,710,808	6,562,274	6,517,000	6,185,000	8,127,000
Total Beet-sugar production	7,223,155	7,153,971	6,984,171	6,904,218	6,651,364	8,579,711
Total Cane and Beet Sugar	13,964,988	14,506,811	13,900,539	14,531,108	14,495,692	16,846,000

Willett & Gray. Tons of 2240lb.

* Cane growing experiments are to be made in the South of France.—*International Sugar Journal.*

WHERE THE SUGAR WE IMPORT COMES FROM

These tables are compiled and transposed from the Board of Trade returns. Within brackets are given the months when sugar production begins. The Southern States of America start making in September, Mexico and Formosa in December, and Australia and Fiji in June.

Raw Cane Sugar

	1909. Tons.	1910. Tons.	Value (£).
Java (May)	83,111	118,304	1,605,161
Cuba (December)	1,058	96,332	1,371,633
Peru (October)	39,586	46,206	587,881
Brazil (October)	47,180	51,469	618,752
Mauritius (August)	19,348	41,739	590.625
British India (December) ...	3,333	8,870	96,74
Straits Settlements	1,467	791	9,389
West Indies (January), British Guiana (October and May), British Honduras	61,057	78,737	1,146,400
Other Countries	36,253	119,713	1,662,830
Total Imports of Raw Cane Sugar	292,393	562,161	£6,689,345
Import of Molasses ...	155,152	155,951	£702,995

Raw Beet Sugar

	1909. Tons.	1910. Tons.	Value (£).
Russia	973	93	1,190
Germany	373,315	229.970	2.640,063
Netherlands	25,723	20,294	235,163
Belgium	19,333	10,996	127,780
France	2,135	436	6,116
Austria-Hungary	100,781	57,918	718,809
Total Raw Beetroot Sugar	522,260	319,707	£3,728.931

Foreign Refined

	1909. Tons.	1910. Tons.	Value (£).
Russia	29,980	2,289	27,357
Germany	416,432	325.792	5.096.587
Netherlands	118,441	118,161	1,813,659
Belgium	41,129	49.460	743.855
France	86,665	60,987	1,007,694
Austria-Hungary	232,617	199.466	3.102.756
Other Countries	20,240	80,707	1,369,115
Total Foreign Refined (practically all Beet Sugar*)...	945.504	846,862	£13,161.023

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* Up to 1900. But in 1910, owing to the shortage of Continental beet crops, we imported some white sugar from Java and Mauritius.

EXPORTS OF BRITISH REFINED

	1909. Tons.	1910. Tons.	Value (£).
Sweden	35	5	157
Norway	683	2,945	44,570
Denmark	5,368	4,055	56,113
Netherlands	3,612	3,296	48,418
Belgium	416	470	6,730
Portugal, the Azores, and Madeira	1,088	1,829	26,006
Italy	1,022	930	11,655
Other Countries	20,032	17,882	305,595
Total Exports of British Refined Sugar	32,256	31,416	£499,244

HOME CONSUMPTION

	1909. Tons.	1910. Tons.	Value (£).
Foreign Refined Sugar ...	924,521	823,602	13,161,023
British Refined Sugar manufactured (in bond) in the United Kingdom	599,793	636,751	......
Raw Cane Sugar*	113,582	143,669	6,689,345
	1,637,896	1,604,022	
Less exports of British Refined	32,253	31,416	499,244
Total consumption of Sugar	1,605,640	1,572,606	
Molasses (imported)	142,030	155,951	702,995
Molasses manufactured (in bond) in United Kingdom† ...	67,973	67,969	
Total consumption of Molasses	210,003	223,920	

SUMMARY OF IMPORTS IN 1909 AND 1910

	Tons.		Tons.			Value (£).
Foreign Refined, practically all Beetroot Sugar ...	945,504	945,504	846,802	846,862	13,161,023	13,161,023
Raw Beetroot Sugar	522,260		319,707		3,728,931	
Raw Cane Sugar ...	292,393	814,653	562,161	881,868	6,689,345	10,418,276
		1,760,157		1,728,730		£23,579,299
Total Beet Sugar...	1,467,764		1,166,569		16,889,954	
Total Cane Sugar...	292,393	1,760,157	562,161	1,728,730	6,689,345	£23,579,299

---

* This is the yellow crystallised from Demerara, Trinidad, &c. (part of the 562,161 tons, total imports of raw cane), which goes into direct consumption. † Mostly golden syrup.

SUGAR BEET AS FOOD FOR STOCK

When Continental growers of sugar beet find that a crop has not a reasonably high sugar percentage they usually find it more profitable to feed it to stock. Horses are particularly fond of sugar beet. In the *Journal of the Board of Agriculture*. Mr. A. D. Hall explained that the roots can be clamped and stored like mangels to be used in the same way as food for stock. "For this purpose, it should be remembered that they possess, roughly, twice the feeding value of an equal weight of mangels. They can be used as food at an earlier date than mangels, because they have, as a rule, attained a higher degree of maturity when they are harvested. Sugar beet should always be sliced or pulped."

SUGAR BEET AS A KITCHEN VEGETABLE

A Suffolk farmer is quoted as follows in the *East Anglian Times*, June 13, 1911: "When it is being thinned out, the little plants make an excellent dish when boiled, and all the women who thinned them out, in addition to having 1s. 3d. a day for the work, took home a bundle of the plants for their dinners. Later on, about August or September, I boiled several of the roots and put them outside on my window-ledge, with a knife and fork. They were not there long, which showed what the villagers thought of them as a vegetable. I also pickled some of the roots, and they were excellent."

SUGAR BEET FOR ALCOHOL

Mr. W. C. Easdale, writing in the *Mark Lane Express* (Feb. 12, 1911) in regard to the operations at a Hungarian beet-growing farm, the cultivation system of which he describes in Chapter XII., says:

"The roots are now converted into sugar, and the tops only are used for the manufacture of alcohol. Each ton of roots yields about 286 lb. of sugar, and each ton of tops produces about 17 gallons of absolute alcohol; but if the whole of the root is used for this purpose 1 ton produces about 19 gallons of absolute alcohol. The profit gained from the conversion of beet is as follows—per ton of roots:

	£	s.	d.	£	s.	d.
Income from sale of 19 gallons of absolute alcohol at 28s per gallon				26	12	0
Expenditure—Repayment of capital and interest on building	0	0	10			
On machinery	0	3	8			
Cost of operation, including refining ...	0	12	6			
Excise duty at 25s. 10d. per gallon of absolute alcohol = 25s. 10d. × 19 ...	24	10	10	25	7	10
Net profit per ton of roots				£1	4	2

To which must be added the value of the leaves and slices as fodder. From these figures it would appear to be possible for farmers to obtain as much as £1 4s. 2d. per ton for their sugar beet, as well as the value of the leaves and slices for fodder, by utilising the roots for the production of alcohol."

In France there is some competition between the sugar manufacturers and distilleries for beets, in which the distilleries are said to come off the better.

MOLASSES FOR ALCOHOL

A use for beet molasses beyond cattle food is in the manufacture of alcohol, including that for denaturing purposes. Dr. Townsend says: "One gallon of beet molasses, containing about 50 per cent. of sugar, weighs approximately 12lb., and will yield about 3 pints of 95 per cent. alcohol; therefore, a 50 gallon barrel of waste molasses will produce about 19 gallons of 95 per cent. alcohol. Besides alcohol, the distilleries produce as a by-product fusel oil, and the remaining slop or refuse is of great value. Waste molasses is also utilised to some extent in the manufacture of vinegar of a very satisfactory quality. The slop or refuse of a distillery contains the salts and organic matter that were present in the molasses. From the concentration of this slop potash salts are obtained, and nitrogen compounds are prepared in Germany and other foreign countries that are used as fertilisers. When these methods of disposing of the waste molasses are practised, approximately all the material extracted from the beet is utilised. When the value of denatured alcohol is better understood it will undoubtedly come into more general use, and it is probable that waste molasses will form an important source of this product. In some countries a portion of the waste molasses is utilised in the manufacture of briquettes by mixing coal dust with molasses, pressing, and drying."

MARVELS OF CANE SUGAR

A medical baronet wrote to the *British Medical Journal* of April 1, 1911, strongly supporting the use of *cane* sugar, as Dr. Goulston has done, in cases of cardiac failure, anæmia, and neurasthenic manifestations of neurotic persons, and added: "I have found it useful to recollect that cane sugar may be distinguished from other forms of sugar by its luminosity in the dark when two lumps are rubbed together." Needless to say, exactly the same phosphorescence can be produced with beet sugar! As to the prescription of cane sugar by medical men, where do their patients get it? Tate's are now the only producers of cane loaf in the United Kingdom. Refined cane can be had from one of the Greenock refiners, but not loaf.

"Sugar" is known to chemists as "sucrose," the definition of which is "the white crystalline compound known variously as cane sugar, beet sugar, maple sugar, &c., according to its origin, but identical chemically, having the composition ($C_{12} H_{22} O_{11}$)." Being identical, it is impossible to distinguish one from the other by looks or by analysis.

There are some imperfectly made sugars, both beet and cane (says Mr. T. G. Palmer, Secretary of the American Beet Sugar Association), where a minute fraction of 1 per cent. of the impurities remain, where the colour is grayish or blueish, or where the crystals lack lustre, and the housewife may obtain indifferent results by their use, but this is no indication as to whether the sugar be cane or beet. It may occur in both cane and beet sugar. Some lump sugar dissolves more rapidly than other lump sugar because it is more porous.

CONTINENTAL AND ENGLISH LUMP SUGAR

On page 18 the words "of the Paris restaurant" should be deleted. As a Continental sugar manufacturer writes to me, in the case of sparkling lump sugar the sugar loaves and slabs are cut by means of disc-saws into strips, and the strips are cut by a sort of mechanical scissors into cubes, and these are called "cut cubes," as contrasted with "press cubes." A great many of the lumps used in France, Belgium and Holland, though not sparkling, are still cut lumps. The only difference between the Continental lump and the English lump, besides the shape, is that the Continental lump is always made of very fine crystals and the lump for England is always made of coarse crystals. The French loaf sugar crystallises in the moulds after it leaves the pan. English loaf sugar is crystallised in the pan. The first is, therefore, a dull conglomerate; the second a brilliant assemblage of clear crystals.

VALUE OF SLICES

As indicated on p. 214, different factories may have different analyses of "dried slices." On three samples sent to Professor T. B. Wood, of Cambridge, he kindly reports: "One contained just over 30 per cent. of sugar. In appearance it differed entirely from the other two; it had a moist look, and was rather soft, and tough and tacky to the touch. The other two are hard, dry, and brittle. One of them contains 6 per cent. of sugar, and the other 6·2 per cent." A Hesse factory sends me this analysis: Water, 7-8 per cent.; protein, 7-7·5 per cent.; fatty substance, 1·3 per cent.; nitrogen, free extract substances (carbo-hydrates), 50-54 per cent.; raw fibre, 7-8 per cent. Mr. Koppeschaar, in the *International Sugar Journal*, gives the following analysis:

Dry substance, 88 per cent.

	Raw food. Per cent.	Digestible. Per cent.
Protein	8·1	4·1
Starchy substance	58·5	50 4
Raw fibre	17·6	12·7
Fat	0·6	—

Also this of sugar pulp: "Dry substance, 91·46 per cent.; protein, 6·97 per cent.; fat, 0·4 per cent.; starchy substances (of which about 35 per cent. is sugar); raw fibre, 11·81." He adds: "While there is no doubt as to this sugar pulp being a very good food for cattle and horses, it is no real by-product, but represents a form in which sugar may be sold." A Dutch sugar manufacturer writes to me: "Sugar slices ('sugar pulp') are too dear. The only advantage is that horses can eat more of them than of non-sugary dried slices. For cows ordinary dried slices are certainly better. A cheaper way of feeding horses is to give a smaller quantity of dried slices than are given to cattle and mix a fairly large quantity of molasses with them." Dried slices containing 4 per cent. of sugar were quoted to me at £4 8s. 9d. f.o.b. Rotterdam, in June, 1911. The real significance of sugar food analyses and the actual value of sugar foods are not always apparent to those who have made no study of the subject. The warnings contained in an article on "Molasses and Sugar Foods for Live Stock," in the *Board of Agricultural Journal*, May, 1911, and in another article in the same publication, August, 1910, are well worth reading. There is no doubt that dried slices are an attractive stock food to handle; but the buyer needs to assure himself of the actual monetary value of the sort offered to him in comparison with other sugar foods. Whether in England it would be profitable to leave much sugar in the beets once they were at the factory remains to be seen.

Preserving Wet Slices

The General Council of the Department of the Pas de Calais, France, has issued a report recommending the preservation of beet pulp by means of lactic fermentation. A special preparation called "lacto-pulp" for setting up lactic fermentation has been placed on the French market. About 66,000 tons of pulp from distilleries and sugar factories were treated by the "lacto-pulp" during the 1909-10 campaign. It is said that among the advantages of the new process are that it does away with the disagreeable smell of the pulp, produces a more appetising food, and saves some loss in weight.

GERMAN RAILWAY RATES

From an examination of the tariff of the German railways—they belong to the State—it would appear that 300 German tons (a German ton is 19 cwt. 2qrs. 20½lb.) of beet can be sent 10⅝ miles for a fraction over £20, which is, roughly, about 1s. a ton.

OUR PRESENT ROOT CROPS *VERSUS* SUGAR BEET

It is a little remarkable how reticent agricultural writers are on the cost of producing the mangel which is so readily compared with beet. Four of the best-known agricultural works of reference are silent on the subject. In one of the sanest papers ever written on the beet sugar question—it was read before the British Association in 1900 by Mr. A. D. Hall, F.R.S.—the then Principal of the South-Eastern Agricultural College, made up the cost per acre at Wye as follows:—

		£	s.	d.	£	s.	d.
1897.							
Aug. 20.	Broadsharing barley gratten	0	5	0			
	Dragharrowing twice	0	2	0			
Sept. 20.	Carting 18 loads dung ¾ mile	0	18	0			
	Spreading	0	2	6			
Oct. 1.	Deep ploughing, 4 horses	0	17	0			
1898.							
April.	Broadsharing deep	0	4	0			
	Harrowing, 3 horses	0	1	0			
	Broadsharing	0	4	0			
	Harrowing, 2 horses	0	1	0			
	Rolling, 2 horses	0	0	9			
1899.							
May 8.	Drilling, washes, and super	0	2	0			
	Harrowing, 1 horse	0	0	7			
	Rolling, 2 horses	0	0	9			
	Hand-hoeing	0	5	6			
	Setting-out	0	7	6			
	Sowing, manure and carriage	0	0	4			
	Hand-hoeing	0	4	0			
	Sowing nitrate and carriage	0	0	4			
	Weeding	0	3	6			
	Raising	0	10	0	4	9	9
Manure:	Artificial	2	1	0			
	Dung	2	5	0	4	6	0
1 acre mangel (the crop was 29 tons) cost					8	15	9
For sugar beet (Wye crop was 14 tons dirty, 12·6 tons washed) add:—							
	Extra hoeing and setting out				0	7	6
	Extra for lifting				1	5	0
1 acre of sugar beet cost					£10	8	3

(In passing it may be noted that the advocate of sugar beet would suggest that £1 15s. would not be spent for raising when the crop was understood.) Mr. Hall added that his £8 15s. 9d. and £10 8s. 3d. did not include "rent, rates and taxes (£1), the cost of supervision, interest on capital, &c., and such charges as are difficult to apportion, but represent the bare cost of growing the crop."

Many farmers are of opinion that mangel does not cost them more than from £5 to £6 10s. A valuer's figures are: £7 5s. 6d., allowing 25s. for rent, rates, and taxes. The amount of another authority is £8 10s., not counting dung or rent, &c. On Lord Rayleigh's estate (1909-10) the cost of 10 acres was £102 2s. 1d. (counting rent, &c., £13 10s., and £4 10s. unexhausted manure). Against this, mangels £139 5s., and unexhausted manure £12 15s. Profit, nearly £5 an acre. During the discussion at the Farmers' Club in 1894, the cost of producing roots was put at between £5 and £14. Dr. Voelcker in his paper read before the Farmers' Club in 1898 gave the following costs for roots:

	Light land (clean).	Medium land (fairly clean).	Heavy land (needing cleaning).
Cultivations previous to sowing	25·3	37·6	49·9
Seed, drilling, &c.	5·6	8·0	8·0
Manuring	35·0	35·0	35·0
After cultivation and harvesting	16·6	21·6	26·6
Rent, rates, taxes, &c.	25·0	25·0	25·0
	107·3	127·0	144·3
Add ¼ for loss and failure of plant, etc.	26·9	31·9	36·0
	134·0	158·9	180·3
or	£6·15	£8	£9

His conclusion was that roots do pay.

It is argued that there is a good sale for mangels; yet in some districts they are given away—that is, if the owner of the stock sent to consume them agrees to add a certain amount of cake. As to the good sale in some districts, however, there can be no doubt. Mr. W. E. Sawyer sent me, on May 12, 1911, an advertisement from a daily paper of that date, in which Eastern Counties farmers were asking, in one case 10s., in two cases 15s., and in a single case 16s. at the hale (clamp). The price quoted at Leicester the same day was 16s. to 18s. Mr. Sawyer wrote:—"One of the almost unanswerable arguments advanced against the growing of sugar beet is that if a farmer is going to sell roots at all he prefers to sell mangel, of which he can grow double the crop at about two-thirds the cost. Certainly in this case there would be no return of pulp in any form, and probably, if a large amount of mangel were grown for sale all over England, the supply would greatly exceed the demand. But in existing circumstances there is no doubt whatever that a price of 10s. to 15s. per ton at the hale in Norfolk is more profitable than sugar beet can ever be. If, however, we look into the matter from a future point of view, it is a bit different. Naturally a landlord objects to roots grown specially for cattle grazing being sold off the farm, and would at once insist on the manurial equivalent being returned, which is about 3s. 2d. per ton. So, also, the landlord will insist on sugar beet growers doing the same, as up to the present we have no home-made figures of the value sugar beet tillage has on the improvement of the crop. One of the great points will be to be able to replace the sugar beet by slices, dried or wet, at a reasonable figure, so that the old-fashioned grazing for which Norfolk is noted shall not be diminished. If this can be arranged, no doubt then sugar beet growing, on account of it improving the soil, will more than hold its own against mangel selling."

An agricultural writer of eminence writes:—"The argument is used in support of beet growing that the deep cultivation required is conducive to the success of the other crops in the rotation. This may possibly be the case, but the same thorough tillage would be equally effective if adopted in preparation for the other root crops. It is the cultivation, and not the crop, that is responsible for the beneficent after-effects, and although mangels and swedes do not penetrate to the depth of beet, they would be responsive to the same indulgent treatment, and leave at least as much residue for the succeeding crops." But is not this statement as to residue just what is disputed? Mr. E. Nicol, of Snape, in sending to a local paper the costs of growing different crops locally, says: "Mangel leaves about five tons of tops on the land; sugar beet a weight equal to the crop." Then as to deep ploughing. It is perfectly true that "the same thorough tillage would be equally effective" with other crops, but may it not be fairly contended that the introduction of sugar beet might hasten the more general adoption of deeper ploughing for other crops?

As to cultivation with the hoe, a correspondent who knows rural England and rural Germany writes to me:—"Go into a beet field in September, and you see no weeds. Go into a mangel field, and, unless very well done indeed, there would be weeds. When I came to England I tried to grow mangels as close as roots are grown in Germany. I could not, the ground was so dirty. The incentive to growing beet is that you get a crop which is really a cleaning crop. Do people realise what a perfect cleaning crop would do for us in England? In the narrower drills there would be no chance of weeds. Of one thing I am certain, the high-class German farmer would rather grow beet at a small loss than not grow it at all, the preparation for the following crops being all important. There is not the slightest doubt beet cultivation cleans the ground better than anything else. The yields of grain, &c., have increased by leaps and bounds since the introduction of the sugar beet. "When I travel with Germans, their incessant remark is, 'We cultivate our fields in Germany much better than you do here,' and when they see fields given over to weeds, as one sometimes does, they then say, 'We would have that man prosecuted for damage to his neighbour's fields.' I am afraid Germany is sharper in the matter of weed suppression than England. A man is made to cut his hedge thistles. If the landlord does not deal with him the local authority does."

It is not out of place, perhaps, to add here the following from Professor Ware, an American authority on beet: "The ash absorbed by growing one ton of mangels is 38·2lb., while with beets it is 34·5lb., thus proving mangels more exhausting to the soil than sugar beets."

THE EXCISE ON SUGAR

The following is an extract from a letter from the Prime Minister dated March 20, 1906, *i.e.*, when he was Chancellor of the Exchequer: "Under the Law as it at present stands, there is no excise duty upon sugar produced in the United Kingdom; but, in the event of sugar being produced here, the provisions of the Convention would require the imposition of such a duty of such amount as would reduce the difference between the duty paid by home-grown and that paid by imported sugar to the limit fixed by the Convention. Further, it would, in Mr. Asquith's opinion, be necessary, for the protection of the revenue, that such excise duty should be equivalent to any customs duty which might at the time be chargeable upon imported sugar."

The undertaking as to a rebate was renewed by Mr. Lloyd George, House of Commons, March 9, 1910, and the value of it has been calculated as "at least 50 per cent."

DISEASES OF BEET ROOTS

One who has urged the introduction of sugar beet culture into this country admits that "the sugar beet is specially prone to animal and vegetable parasites." Continental and American sugar beet literature is full of writing about disease. A great deal of it is due, no doubt, to continuous cropping, to imperfect rotations, and to bad cultivation. The Wohanka people, writing for farmers in the Western and largely arid irrigated states of America, deals with the following fearsome list:

Leaf spot (*Cercospora beticola*).
Root rot (*Rhizoctonia violacea*, or *Helminthosporium rhizoctozon*).
Black root rot (*Phoma betæ*).
Sugar beet webworms (*Loxostege sticticalis*).
Sugar beet nematode, or eelworm (*Heterodera Schachti Schmidt*).
Sugar beet root louse (*Pemphigus betæ Doane* and *Tychea brev cornis Hart*).
Tumour or goitre, or crown gall.

"A sugar beet bearing tumour-like outgrowth," obtained in Norfolk, has already had the honour of a page illustration in the *Journal of the Board of Agriculture.* The disease has been known on the Continent since 1839, and is attributed to growing the crop in sandy soil.

The root itself, Mr. Schobloch tells me, is damaged by *Julus terrestris*, larvæ of *Elater segetis* and *Athous hirtus*, *Polydesmus complanatus*, *Heterodera Schachtii*, *Atomaria linearis. Rhizotrogus solstitialis*, *Agrotis* (Noctua) *segetum*, *Forficula auricularia.* and *Gryllotalpa vulg.* The leaves are injured by *Noctua oleracea*, *N. brassicae*, *N. suara*, *N. chenopodii*, *Plusia Nocturagana*, *Anthomyia conformis*, larvæ of *Silpha atrata*, ditto *Opaca*, *S. reticulata. S. laevigata*, *Cassida nebulosa*, *C. lineola*, *Molytes coronatus. Otiorhynchus raucus*, *Tanymecus palliatus*, *Haltica nemorum*, *Cleonus punctiventris*, and *Psylliodes chrysocephala.* Other diseases are caused by *Uromyces betae*, *Peronospora betae*, *Rhizoctonia violacea*, and *Depacea betaecola.* In "La Betterave à Sucre" some other names are to be found in a dozen pages on "Accidents. Ennemis et Maladies." Most space is given to "the phylloxera of beets," the nematode. Heart rot is common in France. In America, "diseases" are stated to be "the cause of low tonnage."

In a report made to the German Government on the more important attacks on the beet crop during 1909, it is stated that the insects which did damage of economic importance were the cut-worms (*Agrotis* of several species), the leaf louse, and two species of carrion beetles (*Silpha atrata* and *S. opaca*). The remedies or preventives against these are the same as when other crops are attacked by them. Of the fungoid pests, false mildew (*Peronospora Schachtii*) and root disease (*Pythium debaryanum*) did considerable damage, so much so that experiments were made which indicated that deficiency of lime and phosphoric acid in the soil was a favourable condition. Phosphatic manuring, together with the application of dressings of lime and kainit, are recommended as a remedy. Heart, or dry, rot was also a disease doing important damage, and for this a well-drained soil, to which gypsum has been added, is given as a preventive. For the beet wilt, due to the beet nematode (*Heterodera Schachtii*), found present in many crops, crop rotation and soil disinfection with Carbolineum are recommended. Poor physical conditions of the soil, especially if deficient in lime, seemed to favour this disease, as indeed it did with almost all fungoid attacks.

The late Prof. Kühn, a pioneer of scientific agriculture in Germany, gave the following instructions as to how to clean fields infested by nematodes with the help of two or more succeeding crops of catchplants, preferably *brassica rapa oleifera*, which is very readily attacked by these parasites. If horsetackle is to be used for the destruction of the infested catchcrops, the seeding must be plentiful. Use 25lb to 30lb. of seed per acre. For the destruction of the catchplant, the time ought to be chosen when the larvæ of the nematodes living in the small roots of the plant, change their shape. The tail piece which is originally pointed, becomes rounded; for some time the worm-like shape is maintained, later on a swelling takes place, and gives the parasite the shape of a bottle. The head part, however, does not alter much. The worms are now entirely within the roots, which begin to show an irregular surface, with longitudinal protrusions. During the further development, a continuous swelling, the males keep their bottle like form while the females take the shape of a pear. The surrounding tissue is now perforated and the latter end of the larvæ appear on the surface of the roots.

When this takes place immediate destruction of the catchplant must follow. Unluckily, not all the nematodes come to this point of their development at the same time, and therefore a succession of catchcrops is necessary.

Dry weather is most desirable, but the destruction must not be postponed if this does not prevail, because the parasites develop so quickly that to miss the right moment would make matters worse.

To destroy the catchplant the field is drilled crossways to a depth of about 2in. Not quite so deep the first time, and then harrowed. The day following women, with hand hoes chop off close to the surface any plants that may have been left. After repeated use of grubber and harrows the field is now ploughed in ridges (about 7in. wide and 12in. deep). All plants still on the surface are buried in the furrows and covered with soil, so that life very soon comes to an end. The seeding for the following catchplant must be done as soon as possible. With the succeeding catchcrops it is not so easy to determine the right moment when to destroy the plants, because only a small number of nematodes is now present.

If *brassica rapa oleifera* is used the time when the fifth leaf just begins to show will prove, as a rule, to be most promising for the destruction. Never fight nematodes partially. Treat the whole piece at the same time. It is recommended to isolate it by means of a ditch of about a yard deep and at the base half a yard wide. Especially after rain lime ought to be spread along the bottom of the ditch. If after four catchcrops in one year, sugar beet is to follow, give only half the usual amount of nitrates, but the full amount of phosphates.

Mr. Dowling writes to me that during his German tour he noticed the following: (1.) Wireworm (*Agriotes lineatus*), or the common larva of the click-beetle. Considerable damage was caused on land suffering from drought by the wireworm eating through the roots of the young plants in the same manner as it attacks mangels in this country. (2.) Black Aphis (*Aphis papareus*). This aphis is not the same as the dolphin or collier fly that attacks beans, although it belongs to the same family. Some fields of beet on dry sandy soil were rather badly attacked, causing curling and shrivelling up of the leaves. (3.) Beet eelworms (*Heterodera Schachtii*). This is a serious pest in places. Deep and thorough tillage helps to get rid of it; also it is wise not to grow beet or oats on badly infested land for some time.

It was stated in *Czarnikow's Price Current* June 29, that "insects are doing more harm this year than ever before."

One of the highest English authorities on agricultural entomology believes that the worst British pests are as follows: (1.) Cutworms, larvæ of *Agrotis exclamationis* and *A. segetis.* (2.) Pigmy mangel beetle (*Atomaria linearis*). (3.) Wireworms, larvæ of Click Beetles (*Agrotes lineatus* and *Athous hæmorrhoidalis*). (4.) Mangel fly (*Pegomyia betæ*). (5.) Aphides (Poppy Aphis, *Aphis Papareus*). (6.) True Chenopodium Aphides as *Aphis atriplicis*, which is a green aphis causing boat-shaped leaf galls, and *Aphis chenopodii.* a *green* aphis under the leaves. Minor enemies: (1.) Ground Beetles (*Carabidæ*) as *Steropus madidus* and *Harpalus ruficornis*, which eat the roots. (2.) Beet Carrion Beetles (*Silpha atrata* and *S. opaca*). (3.) Millepedes (*Blanjulus guttulatus*).

Of course the importance of the foregoing lists of afflictions which the beet may conceivably undergo should not be exaggerated. They serve to show that the diseases of the sugar beet are taken seriously in the French, German, and Austrian literature dealing with the crop; but we are not to infer that plagues of Egyptian severity will immediately descend on the crop if we go in for it. A long list of assailants of the mangel might be scheduled, but only a proportion is of economic importance.

As insect or other trouble arises, advisory leaflets will. no doubt, be forthcoming from the Board of Agriculture. Meantime. prevention is better than cure. In English soils virgin to sugar beets they have the best possible chance, but those who try to raise crops in unsuitable and imperfectly prepared land, and without the early and perfect singling and the thorough hoeing of the plants, which beet experts insist on, but some of our farmers are disposed to sniff at, will soon lose the advantage they possess.

AMOUNT PAID IN SUGAR DUTIES

1901-2	£6,399,228
1902-3	4,478,707
1903-4	5,725,913
1904-5	6,106,387
1905-6	6,177,953
1906-7	6,250,834
1907-8	6,707,809
1908-09	£3,161,057
1909-10	2,960,202
1910-11 (say) ...	2,960,202
	£50,928,292

ENGLISH BEET SUGAR PIONEER ASSOCIATION.

As this book goes to press, the formation by Mr. Stein of a propagandist organisation under the above name is announced; president, Mr. R. P. Houston, M.P.

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BANGALORE.
27.7.31

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